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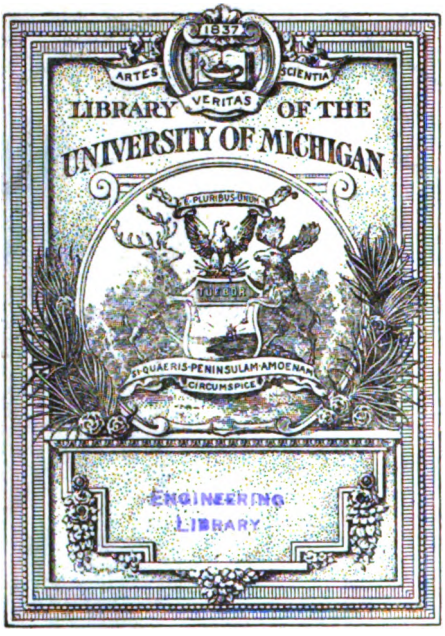

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ANNUAL REPORTS

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FOR THE

FISCAL YEAR ENDED JUNE 30, 1897.

REPORT OF THE
CHIEF OF ENGINEERS.
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RIVERS AND HARBORS.

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REPORT OF THE MISSISSIPPI RIVER COMMISSION.

G. L. GILLESPIE, colonel, Corps of Engineers, U. S. A., president; Amos Stickney, lieutenant-colonel, Corps of Engineers, U. S. A.; Thos. H. Handbury, major, Corps of Engineers, U. S. A.; Mr. Henry L. Marindin, assistant, U. S. Coast and Geodetic Survey; Mr. B. M. Harrod, Mr. Robert S. Taylor, and Mr. Henry Flad, *Commissioners.*

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ANNUAL REPORT

OF THE

CHIEF OF ENGINEERS,

UNITED STATES ARMY.

1897.

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[EXTRACT FROM THE ANNUAL REPORT OF THE SECRETARY OF WAR.]

WAR DEPARTMENT.
Washington, D. C., November 10, 1897.

* * * * * * *

ENGINEER DEPARTMENT.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., October 14, 1897.

Mr. SECRETARY: In compliance with your instructions I have the honor to present the following brief synopsis of my annual report for the fiscal year ending June 30, 1897, which was submitted to you under date of September 30, and to which attention is respectfully invited:

OFFICERS OF THE CORPS OF ENGINEERS.

At the close of the fiscal year the Corps of Engineers consisted of 111 officers, 18 of whom were detached from the command of the Chief of Engineers and on duty at the United States Military Academy, with the Light-House Establishment, with the Commissioners of the District of Columbia, and at the Yellowstone National Park.

The other officers of the corps were busily engaged during the year in charge of important public works connected with permanent fortifications, improvement of rivers and harbors, construction and repair of light-houses, public buildings and grounds in the District of Columbia, Washington Aqueduct, as members of boards of engineers, the Mississippi River Commission, the Missouri River Commission, the California Débris Commission, the torpedo system of defense, and on duty with the Battalion of Engineers and the Engineer School at Willets Point, N. Y.

The important duties devolving upon the Corps of Engineers, together with the expenditure of the great sums appropriated for public works, render it necessary to divide the country into a number of engineering districts, and to place upon the district officers large and varied duties demanding the highest order of ability, industry, and integrity.

There is an urgent need for an increase in the number of engineer troops, both officers and enlisted men. The present authorized strength should be increased by an additional battalion, each company of both battalions to consist of 150 enlisted men officered by one captain and three lieutenants; each battalion should be commanded by a major and the two battalions by a colonel; this would necessitate an increase in the number of officers of the Corps of Engineers. With this increase the engineer regiment should be distributed on the Western, Eastern, and Southeastern coasts in connection with fortifications, torpedo defenses, etc., and the troops should be placed on the same basis as other troops of the line, so that the officers connected with the regiment should have the right to command according to their rank when thrown on duty with other branches of the service.

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SEACOAST DEFENSES.

In accordance with the recommendations of the Board on Fortifications and other defenses appointed by the President under the provisions of the act of March 3, 1885, the Secretary of War has approved detailed projects for the modern artillery defense of the following localities:

1. Penobscot River, Maine.
2. Kennebec River, Maine.
3. Portland, Me.
4. Portsmouth, N. H.
5. Boston, Mass.
6. New Bedford, Mass.
7. Narragansett Bay, Rhode Island.
8. Eastern entrance to Long Island Sound.
9. New York, N. Y.
10. Philadelphia, Pa.
11. Baltimore, Md.
12. Washington, D. C.
13. Hampton Roads, Virginia.
14. Wilmington, N. C.
15. Charleston, S. C.
16. Savannah, Ga.
17. Key West, Fla.
18. Pensacola, Fla.
19. Mobile, Ala.
20. New Orleans, La.
21. Galveston, Tex.
22. San Diego, Cal.
23. San Francisco, Cal.
24. Mouth of Columbia River, Washington and Oregon.
25. Puget Sound, Washington.
26. Lake Champlain, New York.

The first appropriation for the construction of modern gun and mortar batteries was made by the act of August 18, 1890. The following table shows the various amounts appropriated for this purpose up to the present time:

Act of—		Act of—	
August 18, 1890	$1,221,000	March 2, 1895	$500,000
February 24, 1891	750,000	June 6, 1896	2,400,000
July 23, 1892	500,000	March 3, 1897 *a*	3,841,333
February 18, 1893	50,000		
August 1, 1894	500,000	Total	9,762,333

Under allotments made from the above appropriations, emplacements for modern guns and mortars have been constructed or are now under construction at 22 localities as follows:

1. Portland, Me.
2. Portsmouth, N. H.
3. Boston, Mass.
4. Narragansett Bay, Rhode Island.
5. Eastern Entrance, Long Island Sound.
6. New York, N. Y.
7. Philadelphia, Pa.
8. Baltimore, Md.
9. Washington, D. C.
10. Hampton Roads, Va.
11. Wilmington, N. C.
12. Charleston, S. C.
13. Savannah, Ga.
14. Key West, Fla.
15. Pensacola, Fla.
16. Mobile, Ala.
17. New Orleans, La.
18. Galveston, Tex.
19. San Diego, Cal.
20. San Francisco, Cal.
21. Mouth of Columbia River.
22. Puget Sound.

The aggregate of $9,762,333 thus far appropriated under the various acts of Congress for construction of gun and mortar batteries has provided for the following emplacements:

12-inch.	10-inch.	8-inch.	Rapid-fire.	12-inch mortars.
24	82	33	16	232

a Of this appropriation $2,500,000 was for contracts authorized under act of June 3, 1896.

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The total armament proposed under the present projects for coast defense comprises a total of about 32 16-inch guns, 200 12-inch guns, 180 10-inch guns, 100 8-inch guns, 250 heavy rapid-fire guns, 1,032 12-inch mortars, and 24 10-inch mortars. These figures are subject to slight changes as the work progresses, but show approximately the total armament that will be required for an adequate defense of our sea and lake ports. It will be observed that Congress has thus far provided for 139 emplacements for 8, 10, and 12-inch guns out of a total of about 480 required under present projects, and for 232 mortar emplacements out of a total of about 1,056 required.

The aggregate of all appropriations for gun and mortar emplacements prior to the act of June 6, 1896, amounts to $3,521,000. At the beginning of the fiscal year these funds had either been expended or allotted for the following emplacements:

12-inch.	10-inch.	8-inch.	Rapid-fire.	12-inch mortars.
8	21	7	2	80

The acts of June 6, 1896, and March 3, 1897, carried appropriations for gun and mortar batteries amounting to $6,241,333, or nearly double those of all previous acts combined. The following summary shows the emplacements that have been provided under the last two acts:

	12-inch.	10-inch.	8-inch.	Rapid-fire.	Mortars.
Act of June 6, 1896	13	53	23	14	88
Act of March 3, 1897	3	8	3	.....	64
Total	16	61	26	14	152

The emplacements provided under the act of June 6, 1896, are being constructed partly by hired labor and partly by contract, under that clause of the act which provides:

That contracts may be entered into, under the direction of the Secretary of War, for materials and work for construction of fortifications, to be paid for as appropriations may from time to time be made by law, to an additional sum in the aggregate not to exceed two million five hundred thousand dollars.

At the close of the fiscal year the following guns and mortars were mounted and in readiness for service:

12-inch.	10-inch.	8-inch.	Mortars.
10	18	5	73

In addition, there were completed and ready for armament on the same date the following emplacements:

12-inch.	10-inch.	8-inch.	Rapid-fire.	Mortars.
4	29	4	6	39

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At the close of the calendar year it is expected that there will be completed, armed, or in readiness for armament the following emplacements:

12-inch.	10-inch.	8-inch.	Rapid-fire.	Mortars.
19	60	31	9	168

It is expected that the remainder of the emplacements so far provided for will be completed by July 1, 1898, by which time all funds for gun and mortar emplacements will be practically exhausted.

The acts of June 6, 1896, and March 3, 1897, appropriated $100,000 and $150,000, respectively, for submarine mine defenses. These appropriations have been or are being expended, partly in the construction of mining casemates, cable tanks, and torpedo storehouses, and partly in the purchase of such submarine mine material as is not subject to rapid deterioration, and which can not be procured rapidly in an emergency.

The appropriations of $500,000 and $300,000, respectively, in the acts of June 6, 1896, and March 3, 1897, for the purchase of sites for seacoast defenses have either been expended or pledged. The sites needed to accommodate projected batteries are being procured either by direct purchase from the owners whenever reasonable prices are offered, or by condemnation proceedings instituted by the Department of Justice.

ESTIMATES.

The estimates for the engineering work of seacoast defenses for the fiscal year ending June 30, 1899, are:

For gun and mortar batteries	$5,000,000
For submarine mine defenses	150,000
For sites	500,000
For preparation of plans for fortifications	5,000
For protection, preservation, and repair of fortifications	100,000
For sea walls and embankments	55,000
Total	5,810,000

UNITED STATES ENGINEER SCHOOL.

The object of the United States Engineer School at Willets Point, N. Y., is to provide a post-graduate course in engineering for the young officers of the Corps of Engineers, and to give them practical instruction in their duties with engineer troops, in submarine mining, and in higher civil and military engineering, in order to better fit them for the important and responsible work which devolves on the Corps of Engineers. Selected officers from other branches of the service are also detailed for instruction in submarine mining. The present course for engineer officers is three years, and for officers of other arms one year. The garrison consists of three companies of engineer troops, under the battalion commander. The advantages offered by the school in training young engineer officers for their future duties and in imparting a knowledge of the adopted submarine-mine system to officers of other arms are of the greatest importance.

Attention is invited to the estimate of $41,000, presented in detail in my report of September 30, for the Engineer Depot and School at Willets Point.

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RIVERS AND HARBORS.

The condition of the various works for the improvement of rivers and harbors carried on under appropriations made by Congress is given in detail in my report for the past fiscal year.

The total amount actually expended for the improvement of rivers and harbors during the fiscal year ending June 30, 1897, is as follows:

For general improvement of rivers and harbors	$10,612,268.75
For removal of wrecks	35,158.51
For operating dredge boats and snag boats	136,260.56
For operating canals and other works of navigation	678,253.00
For work under Mississippi River Commission	1,595,975.98
For work under Missouri River Commission	387,326.39
For gauging waters of the Lower Mississippi River and its tributaries	6,145.83
For examinations and surveys of South Pass, Mississippi River	*a* 10,006.50
Total	13,461,395.52

Since the last report was submitted appropriations for rivers and harbors have been made by the sundry civil act of June 4, 1897, and the deficiency act of July 19, 1897, the former providing $19,121,412.91 and the latter $1,211,000 for the fiscal years ending June 30, 1897 and 1898.

The total estimate submitted for the fiscal year ending June 30, 1899, for continuous work authorized by Congress and by the Secretary of War is $18,098,007.56. None of this amount has yet been expended, but, as permitted by law, a portion of it has possibly been earned by contractors in advance of its appropriation. The items making up this amount are such as Congress has authorized to be expended during the year ending June 30, 1899, at the various localities for which continuing work is authorized, and Congress has virtually pledged itself to provide the amounts for which requisition is made.

In addition to the estimate submitted for work under continuing contracts, an estimate is presented for the construction and maintenance of works which have been authorized by Congress, but not provided for by such continuing contracts, amounting to $30,630,153. The items making up this amount are those presented for the various works by the engineer officers in local charge as the amounts that should be appropriated, under the law requiring that the amount shall be stated which can be profitably expended in carrying on the projects adopted by Congress, during the fiscal year ending June 30, 1899. The use of the estimates of the local officers in making up this total is in accordance with your instructions, and the estimates are submitted in accordance with the requirements of sections 2 of the river and harbor acts of 1866 and 1867 and the sundry civil act of June 4, 1897, which provide—

* * * And it shall be the duty of the said Secretary * * * and he shall accompany said report with a statement of the amount and date of all former appropriations for each work, and a full estimate for its entire and permanent completion, with the amount that can be profitably expended in the next fiscal year. * * * (Act of June 23, 1866, and repeated in act of March 2, 1867.)

* * * And hereafter the Secretary of War shall annually submit estimates in detail for river and harbor improvements required for the ensuing fiscal year to the Secretary of the Treasury, to be included in, and carried into the sum total of, the Book of Estimates. (Sundry civil act of June 4, 1897.)

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a This amount is exclusive of the sum paid the executors of the estate of James B. Eads for "constructing jetties and other works at South Pass, Mississippi River."

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The act of June 3, 1896, authorized the Secretary of War to enter into contract for the completion of a number of works, and contracts have already been made, or the required preliminary steps to that end have been authorized, excepting in two instances, as follows:

Improving Yaquina Bay, Oregon, continuing improvement, $25,000. Continuous contracts authorized at cost not to exceed $1,000,000.

Improving mouth of Yazoo River and Harbor of Vicksburg, Miss. Continuous contracts authorized at cost not to exceed $860,000.

The act of June 3, 1896, provided for the appointment of a board to examine and report as to location for a deep-water harbor for commerce and of refuge at Port Los Angeles, in Santa Monica Bay or at San Pedro, Cal. This board was duly constituted, and its report, submitted to Congress, was printed in Senate Doc. No. 18, Fifty-fifth Congress, first session. The board reported in favor of locating the harbor at San Pedro, and the Secretary of War, under the terms of the act, has given instructions for action preliminary to the publishing of advertisement inviting bids for the work.

The unprecedented high water which accompanied the flood of 1897 in the Mississippi River severely tested the levees constructed, and the information at hand shows that of an approximate length of levees of 1,377 miles on the two banks of the river between Cairo and the Head of the Passes the breaks aggregated in length only 8.7 miles, or about 0.63 of 1 per cent of the whole length. None of the levees built by the United States, however, were broken.

The policy of the Mississippi River Commission having been modified to provide for greater work in dredging, two powerful hydraulic dredges have already been constructed and are in operation, and contracts have been made for the construction of four more.

The Missouri River Commission again calls attention to the fact that the progress of work for the systematic improvement of the river by continuous work by reaches is seriously interfered with by requirements of law which specify numerous localities, separated by many miles, where work is required to be done, notwithstanding a reduction in the money provided by Congress for the work. The results obtained on this river have shown beyond question the practicability of controlling the river, holding its banks, and giving ample channels for navigation; but the cost and uncertainty of permanence of the work and the slow progress heretofore made have been such as to discourage those interested in the effort to improve the river for such a distance as would give promise of building up its commerce to a degree commensurate with the cost of the work.

During the year the channel through the Great Lakes between Chicago, Duluth, and Buffalo was practically completed, and its importance to the interests of navigation is enormous.

The commerce passing through the St. Marys Falls Canal during the navigable season of 1896 comprised 16,239,061 tons of freight, valued at $195,146,842, and through the Detroit River about 27,900,520 tons, valued at about $300,000,000.

The commerce of the Great Lakes has increased so enormously that accurate charts can only be procured by constant examinations and surveys of new shoals as they become known, and corresponding corrections of and additions to the engraved plates; therefore the appropriations asked for these purposes are recommended.

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WASHINGTON WATER SUPPLY.

The subject of the pressing necessities for providing the city of Washington with an increased supply of water is again presented for the consideration of Congress, and the matter is one which can not, with justice to the citizens of the capital, be much longer delayed. The estimates for the work will be found in my annual report, and it is recommended that favorable action be taken by Congress during its present session.

ARLINGTON MEMORIAL BRIDGE.

The sundry civil act of June 4, 1897, made provision for surveys, etc., for a memorial bridge from the old Naval Observatory grounds in this city to Arlington National Cemetery, and operations under this provision of law are being carried on as rapidly as circumstances will permit.

DEEP WATERWAYS BOARD.

The sundry civil act of June 4, 1897, also provided for the appointment of a board to make such surveys and examinations of deep waterways between the Great Lakes and the Atlantic tide waters as recommended in the report of the Deep Waterways Commission transmitted to Congress January 18, 1897. The board has been constituted by the appointment of Maj. Chas. W. Raymond, Corps of Engineers, and Messrs. Alfred Noble and George Y. Wisner, civil engineers, and is now engaged in the duties assigned under the provisions of the act.

ARANSAS PASS BOARD.

The board of engineer officers to be appointed under the provisions of the sundry civil act of 1897, to ascertain the character and value of the improvements made at Aransas Pass, Texas, was duly constituted and is now engaged in the performance of the duty imposed, and it is expected that the examination of this subject will be completed in time to permit its report to be submitted to Congress on the first Monday in December next, as required by the act.

PUBLIC BUILDINGS AND GROUNDS IN WASHINGTON, D. C.

The improvement of public buildings and grounds and maintenance of the Washington Monument have been carried on under appropriations made by Congress, and, as far as funds permitted, the work has progressed in such manner as to secure the best results. The estimates for this purpose for the coming fiscal year are given in detail in my annual report, and amount to $250,631.

MILITARY MAPS.

Special attention is invited to the item relative to the compilation and publication of military maps for use of the War Department, and particularly those required in connection with harbors adjacent to new fortifications. An appropriation of the small amount asked for is strongly recommended.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

The SECRETARY OF WAR.

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The foregoing concise statement clearly summarizes the important work committed to the charge of the Corps of Engineers.

The time seems to have arrived when an increase in the number of officers and enlisted men of that corps is indispensable. The immense work intrusted to a few men is overtaxing, and it is believed a great saving of money in securing efficient and thorough work by contractors in fulfillment of their contracts would be effected by detailing a young officer to remain on each work under construction or improvement to see that day by day all material as purchased, both in quality and quantity, and according to specifications, is furnished. It is absolutely impossible for one man, having a large number of works a long distance apart, to constantly supervise the construction of improvements in his charge. This is one special reason why it is believed that an increase of cadets at West Point will be beneficial, as more than formerly can be assigned to the Engineer Corps and profitably employed, while the experience thus gained will be of great benefit to them in future years in the line of their profession.

I invite attention to the remarks of the Chief of Engineers on the subject of seacoast defenses, in which he gives the progress of the work on gun and mortar batteries and emplacements. Seacoast defenses are being rapidly constructed, and they should be completed at the earliest possible date. I can not emphasize this too strongly, and therefore urge that the full amount of the estimate be appropriated.

The estimates for river and harbor improvements submitted by the Chief of Engineers have been prepared in accordance with the requirements of law. (Acts of June 23, 1866; March 2, 1867, and June 4, 1897, quoted by him.) They greatly exceed former estimates, and, while I hesitate to express an opinion in matters so fully within the knowledge of members of Congress, I can not refrain from stating the result of my observations since my connection with the Department. It is true that I have not had an opportunity to make a personal inspection of many of the works in question, yet with the exception of waterways and harbors where there is a large traffic, or where immediate improvement is imperatively needed, I am convinced that the estimates are largely in excess of what they should be at a time when the demands upon the Treasury are as great as now. It is therefore recommended that the amount to be appropriated be largely reduced below the estimates. It is but just to the Chief of Engineers to state that these estimates were made by my direction, that the facts might be placed

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before Congress, showing what the expenditures would be were all the requirements of the above-cited laws complied with.

Special attention is invited to the fact that there are now continuous contracts outstanding that will require an expenditure of over $17,000,000 during the fiscal year ending June 30, 1899; of over $14,000,000 during the fiscal year ending June 30, 1900; $5,700,000 during the fiscal year ending June 30, 1901; $796,000 during the fiscal year ending June 30, 1902, and $345,000 during the fiscal year ending June 30, 1903. It is to be understood that these statements are of course approximate only, but they are believed to be nearly correct.

The total length of single levee line built by the United States on the two banks of the Mississippi River below Cairo does not vary materially from 650 miles, and it is gratifying to note that none of these levees were broken by the recent flood in the river. The breaks in the entire system of levees, approximating 1,377 miles in length on the two banks of the river between Cairo and the Head of the Passes, constructed by the United States, the States, and individuals, aggregated only 8.7 miles, or about sixty-three one hundredths of 1 per cent of the entire system.

DEEP-WATER CHANNEL THROUGH THE GREAT LAKES.

The practical completion of the deep-water channel through the Great Lakes marks the beginning of a new era, and its benefits to the future commerce of the great Northwest, and, indeed, the whole country can be realized to some extent by the marvelous development of the commerce through the lakes in recent years. Without going into details, it will suffice at this time to repeat the statement of the Chief of Engineers that the commerce passing through the St. Marys Falls Canal, to and from Lake Superior alone, during the navigable season of 1896 comprised 16,239,061 tons of freight, valued at $195,146,842, and through the Detroit River, coming from Lakes Superior, Michigan, and Huron, about 27,900,000 tons, valued approximately at $300,000,000.

DEEP WATERWAYS BOARD.

In accordance with the act of June 4, 1897, a deep-waterways board was appointed, consisting of Maj. Charles W. Raymond, Corps of Engineers, U. S. A., Alfred Noble, of Chicago, and George Y. Wisner, of Detroit, with Gen. J. H. Kidd, of Ionia, Mich., as secretary. This board is now in the field and pushing its work forward as rapidly as possible.

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SHIP CANAL CONNECTING LAKES UNION AND WASHINGTON WITH PUGET SOUND.

The work of securing the right of way for the canal free of cost to the Government is in progress. The dimensions of the canal as proposed by the Board of Engineers constituted under the provisions of the river and harbor act of September 19, 1890, which were based upon the size of merchant vessels then employed, are not deemed sufficient to accommodate vessels since built and to be built in the near future. It is thought to be desirable and important that an increase in the size of the locks and depth of channel in the canal sufficient to accommodate commerce and vessels of the United States Navy should be made, and the Secretary of the Navy has accordingly been requested to furnish information as to the depth and width that would be required to afford accommodation to the vessels of the Navy and permit their passage between the Sound and the lakes, in order that the data may be at hand and available for consideration when the detailed plans for the work of construction are being prepared. The right of way now in progress of procurement will, it is believed, permit the increase of dimensions, but should additional right of way be found necessary, the same could probably be secured free of cost to the Government.

As the acceptance by the Secretary of War of the right of way must precede the preparation of detailed plans, it will yet be some time before active operations of construction can be commenced.

I can not too strongly recommend the construction of this canal. Lake Washington is a large sheet of fresh water with excellent banks. It is very deep and, of course, entirely free from tides. The necessity on that great coast of fresh water where sea-going vessels can be repaired and freed from barnacles is most apparent.

MONONGAHELA NAVIGATION COMPANY.

In pursuance of a provision contained in the river and harbor act approved June 3, 1896, proceedings for the condemnation of all the property and its appurtenances of the Monongahela Navigation Company, a corporation of Pennsylvania, were duly instituted through the Department of Justice in the United States circuit court for the western district of Pennsylvania. The value of said property, as estimated and determined by the viewers appointed by the court, amounted to $3,761,615.46.

The award as made by the viewers was accepted, and the Attorney-General, having been requested to inform the War Department as to

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the validity of title, expressed the opinion that the Monongahela Navigation Company was clothed with valid title to all of the tracts, subject, however, to a mortgage of $500,000, upon release of which and payment of the amount of the award valid title would vest in the United States. The mortgage referred to was executed to secure the payment of certain outstanding bonds issued by the company, and upon receipt of satisfactory evidence that said bonds had been canceled and paid, excepting bonds to the amount of $150,000, the sum of $160,000 from the amount of the award was retained to secure final payment thereof, and the balance, amounting to $3,601,615.46, was paid to the navigation company on July 8, 1897, thus opening the Monongahela River to free navigation for its vast commerce.

WASHINGTON AQUEDUCT.

An increased water supply for the city of Washington is an urgent necessity, as stated by the Chief of Engineers.

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REPORT

OF

THE CHIEF OF ENGINEERS,

UNITED STATES ARMY.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., September 30, 1897.

SIR: I have the honor to present for your information the following report upon the duties and operations of the Engineer Department for the fiscal year ending June 30, 1897:

OFFICERS OF THE CORPS OF ENGINEERS.

The number of officers holding commissions in the Corps of Engineers, U. S. Army, at the end of the fiscal year was 111.

Since the last annual report, Brig. Gen. William P. Craighill was retired, February 1, 1897, at his own request, under the provisions of the act of Congress approved June 30, 1882.

There were added to the Corps, by promotion of graduates of the Military Academy, two additional second lieutenants July 10, 1896.

On the 30th of June, 1897, the officers were distributed as follows:

Commanding the Corps of Engineers and Engineer Department	1
Office of the Chief of Engineers and Light-House Board	1
Office of the Chief of Engineers	2
Board of Engineers, Board of Visitors to United States Engineer School, and Division Engineer	1
Division Engineer	1
Board of Ordnance and Fortification, fortifications, river and harbor works, and Division Engineer	1
Board of Engineers, Mississippi River Commission, Division Engineer, and Light-House Board	1
Fortifications, river and harbor works, Division Engineer, and California Débris Commission	1
River and harbor works and light-house districts	1
Fortifications and river and harbor works	37
River and harbor works	20
Mississippi River Commission, Missouri River Commission, and light-house districts	1
River and harbor works and engineer officer, Department of Dakota	1
Missouri River Commission, river and harbor works, and light-house district	1
Mississippi River Commission, Missouri River Commission, and river and harbor works	1
Board of Engineers, fortifications, and river and harbor works	1
Fortifications, river and harbor works, California Débris Commission, and light-house district	1
Board of Engineers, post of Willets Point, United States Engineer School, and Battalion of Engineers	1

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River and harbor works and engineer officer, Department of the Missouri	1
Fortifications, river and harbor works, and light-house districts	2
Battalion of Engineers and United States Engineer School	9
River and harbor works and International (Water) Boundary Commission	1
Public Buildings and Grounds	1
Board of Engineers	1
Mississippi River Commission	1
Missouri River Commission	1
River and harbor works and California Débris Commission	1
Washington Aqueduct	1
Detached, at Military Academy, with Light-House Establishment, with Commissioners of the District of Columbia, and at Yellowstone National Park	18
Total	111

The officers detached were on duty as follows:

Lieut. Col. Oswald H. Ernst, Superintendent U. S. Military Academy	1
Lieut. Col. David P. Heap, engineer Third light-house district	1
Lieut. Col. Andrew N. Damrell, engineer Seventh and Eighth light-house districts	1
Maj. Milton B. Adams, engineer Ninth and Eleventh light-house districts	1
Maj. William R. Livermore, engineer First and Second light-house districts	1
Maj. Ernest H. Ruffner, engineer Fifth light-house district	1
Maj. William H. Bixby, engineer Fourth light-house district	1
Capt. William M. Black, Engineer Commissioner of the District of Columbia	1
Capt. James L. Lusk, and Lieut. Eben E. Winslow, on duty with Company E, Battalion of Engineers, and at U. S. Military Academy	2
Capt. John Millis, engineer secretary of the Light-House Board	1
Capts. Edward Burr and Lansing H. Beach, assistants to the Engineer Commissioner of the District of Columbia	2
Lieuts. Thomas H. Rees, Francis R. Shunk, Chester Harding, and Charles P. Echols, on duty at U. S. Military Academy	4
Lieut. Charles S. Bromwell, locating boundaries of Yellowstone National Park	1
Total	18

THE BOARD OF ENGINEERS.

The regulations for the government of the Corps of Engineers provide for a Board of Engineers. One of the duties of this Board is to plan or to revise, as may be directed by the Chief of Engineers from time to time, projects of permanent fortifications required for the defense of the territory of the United States.

The Board consists of not less than three officers, to be designated by the Chief of Engineers, with the sanction of the Secretary of War. Whenever the defense of any particular locality is under consideration by the Board, the corresponding division engineer is also a member of the Board, and the district engineer may be associated with the Board as a member thereof whenever any subject relating to his district is under consideration.

The composition of this Board during the past fiscal year is given in its report.

(See Appendix No. 1.)

POST OF WILLETS POINT, N. Y.

The post was under the command of Maj. John G. D. Knight, Corps of Engineers, and at the close of the fiscal year garrisoned by 17 commissioned officers and 412 enlisted men, including officers and noncommissioned officers of the general staff, student officers, and enlisted men of the Hospital Corps.

A quartermaster and commissary storehouse and a garbage crematory were erected and a bakehouse commenced. A condemned frame building was torn down. The water system was extended; $11,102 was

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expended by the quartermaster's department on repairs to buildings, heating apparatus, plumbing, wharf, and extension of water system, and $11,112 on new buildings.

There is urgent need of new mess buildings for the three companies stationed here and of a new barracks for the band. The present mess buildings and band barracks are frame, dilapidated, and out of repair. The mess buildings are about twenty-seven years old, and expenditures on them are no longer authorized because of the large sums that would be needed to defray the cost. The band barracks has been characterized by an inspector-general as a shed.

The joint occupancy of the post by engineer and artillery troops has again brought to notice the question of command exercised by engineer officers.

An order of the Secretary of War directed that the artillery while at the post should be subject to the regulations prescribed for the government of the post. But this was construed by one artillery officer as not conferring upon the post commander the right to command the battery. Subsequently this was more directly conferred by an order of the President designating the post commander by name to command both engineer and artillery troops.

Paragraph 17, Army Regulations, limiting the right of engineer officers and of certain staff officers to command, arose indirectly from a dispute which occurred nearly half a century before the existence of any portion of the engineer battalion. It would seem time to amend so much of this regulation as relates to engineer officers serving with engineer troops armed, equipped, and drilled as infantry.

By declaring such troops to be part of the line, and by amending paragraph 17, Army Regulations, to except from its present provisions engineer officers serving with troops of the line, justice could be done without invoking the aid of new legislation.

UNITED STATES ENGINEER SCHOOL.

The commanding officer of the post of Willets Point is the commandant of this school, and its instructors are the company commanders and battalion staff of the battalion of engineers.

The work of this school is of the greatest importance to the Army at large and to the Corps of Engineers in particular, supplementing as it does the elementary knowledge of engineering given at West Point, and giving to the young officers practical training as well as the theoretical knowledge of the works of others, which for them for many years must take the place of that most necessary equipment of an engineer, experience.

During the year two officers of the Corps of Engineers completed the full course of the school, and two officers of cavalry and four of infantry the special course in submarine mining. One officer of cavalry and four of infantry are still engaged in the practical work of planting and operating submarine mines, which will be completed October 1. Two infantry officers voluntarily took a practical course in astronomy and photography.

The instructors discharge their duties as company and staff officers, as well as those connected directly with the school, and have taken earnest interest in their work.

School regulations have been amended in two particulars. The summer course now commences May 1, and the winter course November 1, or each one month earlier than heretofore; and the Board of Visitors

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now consists of the senior member of The Board of Engineers and two officers of the Corps of Engineers designated by the Chief of Engineers, instead of the members of The Board of Engineers, and officers of the Corps of Engineers above the rank of major, stationed in New York City. The Board visits the school annually, instead of twice a year.

BATTALION OF ENGINEERS.

The maximum legal enlisted strength of the battalion is 752 men. The present authorized strength is 500 men, distributed in four companies, one of the five companies allowed by law being a skeleton. Companies A, B, and C are stationed at Willets Point. Company E is at West Point.

During the year all of the companies have been drilled in pontonnering, laying out and constructing fieldworks and intrenchments, and building spar bridges. All have drilled as infantry in the school of the company, and those at Willets Point in the school of the battalion. The companies at Willets Point have also received instructions in loading and planting submarine mines. One noncommissioned officer from Company E is at Willets Point under instruction in submarine mining. Selected men from all the companies have been practiced in signaling, reconnaissance work, and photography. Target practice for the battalion was had at West Point range. During the past summer Companies A, B, and C marched from Willets Point to West Point and returned, and thus obtained needed practice in marching and bivouac. The captain commanding Company E is instructor of practical military engineering at the United States Military Academy. In the instruction of the cadets he is assisted by the officers and men of his company.

The battalion participated in five parades, the unveiling of the statute of Gen. G. K. Warren in Brooklyn, the inaugural parade, the transfer of the tomb of General Grant, the unveiling of the Washington Monument at Philadelphia, and Memorial Day in New York City.

There is an urgent need of an increase in the number of engineer troops, both officers and enlisted men. The present authorized strength should be increased by an additional battalion, each company of both battalions to consist of 150 enlisted men, officered by one captain and three lieutenants, of which two should be first lieutenants. Each battalion should be commanded by a major, and the two battalions by a colonel. This would necessitate an increase in the number of officers of the corps. The needed increase of enlisted men is 700.

With this increase, the engineer regiment should be distributed on the Western, Eastern, and Southeastern coasts.

ENGINEER DEPOT.

The engineer depot is the repository of tools and materials for ponton bridges, sieges, torpedo service, and instruments for surveys and astronomical work upon which the Corps of Engineers may be engaged.

Improvements have been made in the system of submarine mining defense by taking advantage of the advance in electrical science and inventions since the system was adopted. Additional material for this defense has been purchased and shipped, or is to be shipped, to various points.

Surveying instruments have been issued to engineer and acting engineer officers.

The instruction of troops in reconnaissance duty and military map

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making is the reason for recommending that the appropriation for engineer depot, new instruments, be extended to admit of the purchase of drawing materials and instruments for such use.

Small additions have been made to the stock of ponton materials on hand.

STATEMENT OF FUNDS.

Congress has appropriated as follows:

1. For engineer depot at Willets Point, N. Y., for fiscal year ending June 30, 1897	$9,500.00
June 30, 1897, expended and pledged	9,489.55
2. July 18, 1896, allotted for apparatus for tests of cement	376.75
3. Torpedoes for harbor defense, act March 2, 1889, for "Movable submarine torpedoes":	
July 11, 1896, allotted	10,000.00
July 1, 1897, balance available	10,000.00
4. Miscellaneous acts for "Purchase of submarine mining materials and necessary appliances":	
July 1, 1896, balance unexpended	3,804.72
5. Act August 18, 1890, for "Torpedo experiments," etc.:	
July 1, 1896, balance unexpended	18,492.60
July 1, 1897, balance available	2,924.82
6. Act June 6, 1896, for "Purchase of submarine mining materials and necessary appliances":	
July 17, 1896, allotted	32,000.00
July 1, 1897, balance available	5,749.23
7. Act March 3, 1897, for "Purchase of submarine mining materials and necessary appliances":	
April 8, 1897, allotted	75,000.00
July 1, 1897, balance available	75,000.00

(See Appendix No. 2.)

FORTIFICATIONS.

The system of seacoast defenses now in progress of construction is based upon the report of The Board on Fortifications and other Defenses appointed by the President under the provisions of the act of March 3, 1885. The report of this Board, generally known as the Endicott Board, was published in 1886.

Under instructions from the Chief of Engineers dated March 29, 1887, The Board of Engineers undertook the study and preparation of detailed projects for the artillery and submarine mine defense of the principal sea and lake ports of the United States. Up to the present time projects have been prepared and have received the approval of the Secretary of War for the following ports, viz: Penobscot River, Me.; Kennebec River, Me.; Portland, Me.; Portsmouth, N. H.; Boston, Mass.; New Bedford, Mass.; Narragansett Bay, R. I.; eastern entrance to Long Island Sound; New York, N. Y.; Philadelphia, Pa.; Baltimore, Md.; Washington, D. C.; Hampton Roads, Va.; Wilmington, N. C.; Charleston, S. C.; Savannah, Ga.; Key West, Fla.; Pensacola, Fla.; Mobile, Ala.; New Orleans, La.; Galveston, Tex.; San Diego, Cal.; San Francisco, Cal.; mouth of Columbia River, Washington and Oregon; Puget Sound, Wash.; Lake Champlain, N. Y. Projects for the defense of other ports are still under consideration.

Sites.—The great range of modern high-power guns compels the establishment of defensive lines at distances from the cities and harbors considerably greater than heretofore deemed necessary. At many harbors the sites of the older-type works are at distances from the objects to be protected insufficient to admit of a proper defense under modern conditions. At other harbors the areas of the older sites, when otherwise suitable, are too small to accommodate the modern defenses. The

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acquisition of suitable sites has, therefore, been a necessary feature of the construction of a modern system of seacoast defenses. During the past fiscal year title has been obtained to sites at Portland, Me.; eastern entrance to Long Island Sound; Baltimore, Md.; Charleston, S. C.; Key West, Fla.; Galveston, Tex.; San Diego, Cal., and Puget Sound, Wash. Negotiations are still in progress for sites at Portland, Me.; Boston, Mass.; Narragansett Bay, R. I.; eastern entrance to Long Island Sound; Key West, Fla.; Galveston, Tex., and Puget Sound, Wash. All available funds for the purchase of sites for seacoast defenses have been pledged.

The operations attending the acquisition of sites are frequently attended by tedious and unavoidable delays. At several points where defenses are urgently required it has been impossible to proceed with their construction for the want of the necessary land. A number of important sites still remain to be acquired to carry out the approved projects and should be secured as promptly as possible, so that no delays may be experienced in the construction of the emplacements when funds become available. An appropriation of $500,000 is earnestly requested to continue the purchase of necessary sites.

Sea walls and embankments.—The object of this item of the estimates is for the protection of military reservations against encroachments by the sea. The newly-acquired sites at Hawkins Point and Rock Point, Maryland, are seriously threatened by erosion, and to protect them, as well as to complete the shore protection at Fort Morgan, an appropriation of $55,000 is requested. Sufficient provision for the present has already been made for all other works of this character.

Preservation and repair of fortifications.—The appropriations under this item of the estimates are applied to the preservation and repair of fortifications of all types, old and new; to the pay of civilian fort keepers for ungarrisoned works; to the care of their reservations, and to the alterations of the older-type platforms to adapt them to the improved carriages provided for the old armament.

The numerous masonry works of older type, with their existing armaments, constitute valuable adjuncts to the modern system of defense. In many cases they occupy most important sites, and in such the approved projects provide for their modification to receive a modern high-power armament. Their barracks, buildings, cisterns, and casemates will be most useful in connection with the service of the modern batteries, while their armament will be effective in resisting boat attacks and for protecting the mine fields.

As a result of insufficient appropriations during a long period of years it has been impossible to properly care for these works, and many of them are now in a deplorable condition, due to the natural ravages of time and of the elements. Large sums could be advantageously expended in the restoration of these works. The increasing number of new works, with their expensive armaments and machinery, imposes additional demands for care. An estimate of $100,000 is submitted for preservation and repair of fortifications.

New works.—Since the inauguration of the modern system of coast defenses Congress has made appropriations for the construction of gun and mortar batteries as follows:

Act of—		Act of—	
August 18, 1890	$1,221,000	March 2, 1895	$500,000
February 24, 1891	750,000	June 6, 1896	2,400,000
July 23, 1892	500,000	March 3, 1897	3,841,333
February 18, 1893	50,000		
August 1, 1894	500,000	Total	9,762,333

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The aggregate of all appropriations prior to the act of June 6, 1896, amounts to $3,521,000. The acts of June 6, 1896, and March 3, 1897, appropriated, together, $6,241,333, or nearly double the amount of all previous appropriations. As a result of the liberal appropriations made by the last two fortification acts, a most gratifying advance has been made in the number of new emplacements, as is evident from the following table:

Emplacements provided for.

	12-inch.			10-inch.			8-inch F. p. disappearing.	5-inch rapid-fire.	6-pounder rapid-fire.	12-inch mortars.
	Lift.	F. p. disappearing.	Nondisappearing.	C. p. disappearing.	F. p. disappearing.	Nondisappearing.				
Under earlier appropriations	2	.....	6	.....	21	.....	7	.....	2	80
Under the acts of June 6, 1896, and March 3, 1897	.....	12	4	1	56	4	26	12	2	152
Total	2	12	10	1	77	4	33	12	4	232

During the fiscal year the construction of modern defenses was begun at eleven new ports, making twenty-two ports in all where work is now in progress.

The act of June 6, 1896, provided—

That contracts may be entered into, under the direction of the Secretary of War, for materials and work for construction of fortifications, to be paid for as appropriations may from time to time be made by law, to an additional sum in the aggregate not to exceed two million five hundred thousand dollars.

Under this authority contracts were entered into during the fiscal year for constructing the following emplacements:

12-inch.	10-inch.	8-inch.	5-inch rapid-fire.	12-inch mortars.
7	28	17	2	24

With the available balance it is proposed to contract for one additional 10-inch emplacement and for sixteen 12-inch mortar emplacements.

The act of March 3, 1897, appropriated $2,500,000 to meet contracts authorized under the act of June 6, 1896.

The contract system in its application to fortifications is open to grave objections, chief amongst which is the undue publicity necessarily given to the plans to enable intending bidders to submit proposals intelligently. The character of the work is such that perfect freedom to introduce changes during construction is extremely desirable, a freedom that is seriously hampered by the existence of a contract. A comparison of the results accomplished during the past fiscal year between the contract and hired-labor systems shows that the latter is in every way superior, being more rapid, satisfactory, and equally economical. A continuance of the contract system in connection with the construction of fortifications can not be recommended.

The twenty-two ports where modern defenses are under construction comprise all the more important localities. The remaining ports for which modern defenses are contemplated are, with the exception of

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the lake ports, of minor importance and will not require a very extensive or costly armament.

Considering only the twenty-two ports where work is in progress, the emplacements already provided bear the following proportions to the total numbers of emplacements of the different calibers required under the approved projects for these ports:

12-inch emplacements, about one-eighth.
10-inch emplacements, about one-half.
8-inch emplacements, over one-third.
12-inch mortars, about one-fourth.
Rapid-fire guns, about one-fifteenth.

The relatively greater progress made in the 10-inch and 8-inch emplacements is due to the fact that the Ordnance Department has been able to supply the carriages for these in greater numbers. No 12-inch disappearing carriages or rapid-fire guns have yet been issued, although a limited number of each are now in process of manufacture. An increase in the number of 12-inch and of rapid-fire emplacements, particularly the latter, is at present the most urgent need of our seacoast defenses. Rapid-fire guns, by reason of their relatively great power and their rapidity of fire, constitute a highly important element in coast defense. Their emplacements are comparatively inexpensive and can be rapidly constructed whenever the guns and carriages are available for issue.

The following statement shows the condition of the various emplacements at the close of the fiscal year. The emplacements reported as completed are in readiness for their armament and to be used, although in some cases incomplete in nonessential details:

12-inch guns on lifts (number, 2):
2 completed; guns mounted.
12-inch guns on disappearing carriages (number, 12):
4 completed.
5 to be completed December 1, 1897.
3 to be completed July 1, 1898.
12-inch guns on nondisappearing carriages (number, 10):
8 emplacements completed; guns mounted.
2 emplacements to be completed July 1, 1898.
10-inch guns on disappearing carriages (number, 78):
18 completed; guns mounted.
3 completed; carriages mounted.
26 completed; ready for armament.
17 to be completed December 1, 1897.
18 to be completed July 1, 1898.
10-inch guns on nondisappearing carriages (number, 4):
4 to be completed July 1, 1898.
8-inch guns on disappearing carriages (number, 33):
5 completed; guns mounted.
4 completed; ready for armament.
22 to be completed December 1, 1897.
2 to be completed July 1, 1898.
12-inch mortars (number, 232):
73 completed; mortars mounted.
12 completed; carriages mounted.
27 completed; ready for armament.
56 to be completed December 1, 1897.
64 to be completed July 1, 1898.
5-inch rapid-fire guns (number, 12):
2 ready for armament.
3 to be ready December 1, 1897.
7 to be ready July 1, 1898.
6-pounder rapid-fire guns (number, 4):
4 ready for armament.

A considerable number of 10-inch and 8-inch carriages and guns had been issued and were being mounted at the close of the year. It is

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expected that by the end of the present working season nearly all the 10-inch and 8-inch emplacements which are now ready will be provided with their armament.

The cost of the more recent emplacements has been materially less than those first constructed, due, in a large measure, to the adoption of a design involving a reduction of the quantity of concrete and the substitution of sand or earth instead. The greater experience of the constructing officers and the existence of a plant purchased for the earlier operations have also been factors affecting the cost of the later works. The economies thus effected, coupled with the adoption of a successful disappearing carriage for the 12-inch gun, which will serve to replace most, if not all, of the lift mountings originally contemplated, warrant the assertion that the ultimate cost of the engineering work connected with the projected scheme of modern defense will be less than at first estimated.

The funds appropriated for the construction of gun and mortar batteries have now been either allotted or pledged, and it is expected that by the end of the fiscal year 1897–98 these funds will be practically expended. To continue the work now so favorably progressing at all points an appropriation of $5,000,000 is requested.

Submarine mines.—A system of coast defense is not complete without the use of some obstacle to deter an enemy from running past the land batteries. The means employed for this purpose are submarine mines operated electrically from specially constructed casemates on shore. These casemates, as well as the more important items of material, such as the mines, anchors, cables, operating apparatus, etc., can not be provided in an emergency and must therefore be supplied in advance. This material, to be readily available, must be stored at the locality where it is to be used, necessitating proper storage facilities.

Under the act of June 6, 1896, $100,000 was appropriated for "torpedoes for harbor defense," including material and the necessary casemates. With this sum there were constructed three casemates and a number of cable tanks. The balance was devoted to the purchase of material. Under the act of March 3, 1897, the sum of $150,000 was appropriated for the same objects. This appropriation has been applied to the construction of four additional casemates, two special torpedo storehouses, and to fitting up storerooms in existing casemates of old works. The balance was devoted to the purchase of submarine mine material. The total number of casemates constructed or provided for is thirty-seven. An appropriation of $150,000 is requested to continue the work.

The following summaries of the detailed reports of the local officers give a concise statement of the work of the past year:

Defenses of coasts of Maine and New Hampshire.—Officers in charge, Lieut. Col. Andrew N. Damrell, Corps of Engineers, to April 27, 1897, and Maj. Richard L. Hoxie, Corps of Engineers, after that date; assistant, Lieut. George P. Howell, Corps of Engineers, since July 13, 1896; Division Engineer, Col. George L. Gillespie, Corps of Engineers, since April 30, 1897.

The older type fortifications in this district have been kept in repair as far as the limited funds would permit. Of these works one contains an artillery garrison; the remainder are cared for by ordnance sergeants. The modern defensive works are located at Portland Harbor, Maine, and Portsmouth Harbor, New Hampshire.

Work was continued during the year on three emplacements for 10-inch guns for the defense of Portland Harbor, and two additional

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emplacements were commenced with funds appropriated by the act of June 6, 1896. Three of these emplacements were ready for their armament at the close of the year, and all five will be completed during the present working season. Two carriages and four guns for these emplacements have been delivered.

An addition to one of the sites in Portland Harbor was purchased during the year, at a cost of $13,202.50, and a mortar battery for sixteen 12-inch mortars commenced with funds appropriated by the act of June 6, 1896. At the close of the year the excavation for this battery, which is all in ledge, was well advanced.

Under authority granted the Secretary of War by the act of June 6, 1896, contracts were entered into for the construction of two 12-inch emplacements at Portland Harbor, and for two 8-inch emplacements at Portsmouth Harbor. The former contract, under its terms, should be completed December 1, 1897, and the latter October 15, 1897. The contract for Portsmouth Harbor also includes the construction of a mining casemate.

Projects for the defense of the Penobscot and Kennebec rivers have been prepared, and have received the approval of the Secretary of War.

(See Appendix 3 A.)

Defenses of Boston, Mass.—Officer in charge, Lieut. Col. Samuel M. Mansfield, Corps of Engineers; assistants, Lieut. Meriwether L. Walker, Corps of Engineers, from July 14 to December 29, 1896, and Lieut. John S. Sewell, Corps of Engineers, since April 6, 1897.

The defenses consist of three works of older type, eight new emplacements for 10-inch guns on disappearing carriages, and a mortar battery for sixteen 12-inch rifled mortars. Of the new works, four 10-inch emplacements and the mortar battery were under construction during the previous fiscal year. The remaining four 10-inch emplacements were begun during the present fiscal year, three with funds allotted from the act of June 6, 1896, and one with funds from the act of March 3, 1897. The mortar battery was completed in all its details, and has been transferred to the care of an artillery garrison. Three 10-inch emplacements are essentially completed and their armament delivered. This armament is being mounted by artillery troops, two carriages being in place at the close of the year. Four additional 10-inch emplacements are ready for their armament, although considerable work still remains to be done.

Negotiations are being conducted for the purchase of two sites in the harbor, upon one of which a mortar battery for eight 12-inch mortars will be constructed as soon as title passes to the United States. The plans for this battery have been approved and the necessary funds allotted from the act of March 3, 1897.

(See Appendix 3 B.)

Defenses of southeast coast of Massachusetts and Rhode Island.—Officer in charge, Maj. Daniel W. Lockwood, Corps of Engineers, with Lieut. Charles H. McKinstry, Corps of Engineers, under his immediate orders; Division Engineer, Col. (now Brig. Gen.) John M. Wilson, Corps of Engineers, until February 11, 1897, and Col. George L. Gillespie, Corps of Engineers, after that date.

The defenses comprise three works of the older type, one of which is garrisoned, and the others in charge of ordnance sergeants. During the fiscal year the construction of modern works was commenced at Narragansett Bay. An allotment of $125,000 was made from the act of June 6, 1896, for the construction, by hired labor, of a mortar bat-

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tery for sixteen 12-inch mortars. At the close of the year this battery was well under way and platforms for twelve mortars completed and the base rings set.

Under the authority granted the Secretary of War in the act of June 6, 1896, a contract was entered into for the construction of three emplacements for 10-inch guns on disappearing carriages. The contractor is making satisfactory progress, and it is expected that the emplacements will be essentially completed at the close of the present working season. Negotiations for the acquisition of additional sites were carried on during the year, but owing to legal complications these could not be obtained by amicable arrangements, and condemnation proceedings must be instituted.

A project was prepared for the defense of New Bedford, Mass., and has received the approval of the Secretary of War.

(See Appendix 3 C.)

Defenses of eastern entrance to Long Island Sound.—Officer in charge, Maj. Smith S. Leach, Corps of Engineers, with Lieut. William J. Barden, Corps of Engineers, under his immediate orders since June 16, 1897; Division Engineer, Col. (now Brig. Gen.) John M. Wilson, Corps of Engineers, until February 11, 1897, and Col. George L. Gillespie, Corps of Engineers, after that date.

During the fiscal year a project for the defense of this locality was prepared and has received the approval of the Secretary of War.

Under authority granted the Secretary of War by the act of June 6, 1896, a contract was entered into for the construction of two emplacements for 12-inch guns on disappearing carriages. Work under this contract was commenced in March, 1897, and at the close of the fiscal year had progressed in a satisfactory manner.

Negotiations for the purchase of needed sites were carried on during the year and one site secured. Upon this will be constructed a battery for two 10-inch guns on disappearing carriages, to be built by contract under the act of June 6, 1896, and a mining casemate. Plans and specifications for these works have been prepared and approved, and at the close of the year they were advertised.

(See Appendix 3 D.)

Defenses of New York—At eastern entrance to harbor, on islands in harbor, and on Staten Island.—Officers in charge at eastern entrance to harbor, Maj. John G. D. Knight, Corps of Engineers, until July 21, 1896; after that date Maj. Henry M. Adams, Corps of Engineers; of remaining works, Maj. Henry M. Adams, Corps of Engineers; assistant, Lieut. Robert R. Raymond, Corps of Engineers, since July 18, 1896; Division Engineer, Col. (now Brig. Gen.) John M. Wilson, Corps of Engineers, until February 11, 1897, and Col. George L. Gillespie, Corps of Engineers, after that date.

Eastern entrance to harbor.—During the fiscal year work was commenced on two emplacements for 10-inch guns on disappearing carriages with funds from the act of June 6, 1896. At the close of the year these emplacements were ready for their armament and well advanced toward completion. With funds allotted from the act of March 3, 1897, work was commenced upon one emplacement for 12-inch gun on disappearing carriage, one emplacement for 8-inch gun on disappearing carriage, and eight platforms for 12-inch mortars. At the close of the year work had been commenced on these emplacements and platforms. In addition to the new work begun during the year the modern defenses include a mortar battery for sixteen 12-inch mortars and emplacements for two 10-inch and one 8-inch guns on disap-

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pearing carriages, which are essentially completed and armed, except the 8-inch emplacement, for which no gun or carriage had been received.

Defenses on Staten Island.—With funds from the act of June 6, 1896, the construction of four emplacements for 10-inch guns on disappearing carriages was begun, and at the close of the fiscal year these emplacements were essentially completed and awaiting their armament. The emplacements for five 8-inch guns on disappearing carriages mentioned in last Annual Report were completed in all details.

(See Appendix 3 E.)

Defenses of southern entrance to New York Harbor, on Long Island and Sandy Hook.—Officers in charge, Col. George L. Gillespie, Corps of Engineers, until February 23, 1897, and after that date Lieut. Col. William Ludlow, Corps of Engineers; assistant, Lieut. Robert McGregor, Corps of Engineers.

At the close of the previous fiscal year the modern defenses consisted of a mortar battery for sixteen 12-inch mortars, two emplacements for 12-inch guns on lifts, one emplacement for 10-inch gun on disappearing carriage, and two casemates for 6-pounder rapid-fire guns. These were all completed and armed, except the 10-inch emplacement and the rapid-fire casemates. During the fiscal year four emplacements for 10-inch guns and two casemates for 6-pounder rapid-fire guns were commenced with funds from the act of June 6, 1896. At the close of the year these had all been completed, except mounting a portion of the armament. Under authority granted the Secretary of War by the act of June 6, 1896, a contract was entered into for constructing three emplacements for 10-inch guns on disappearing carriages, to be completed November 1, 1897. The progress made has been slow and unsatisfactory. With funds appropriated by the act of March 3, 1897, the construction of two emplacements for 12-inch guns and of one emplacement for 10-inch gun was commenced.

(See Appendix 3 F.)

Defenses of the Delaware River.—Officer in charge, Maj. Charles W. Raymond, Corps of Engineers, with Lieut. Spencer Crosby, Corps of Engineers, under his immediate orders.

The modern works for the defense of the Delaware River, upon which work has been carried on to a greater or less extent during the past fiscal year, consist of one battery of three 12-inch and three 10-inch disappearing guns, one battery of three 12-inch disappearing guns, one battery of sixteen 12-inch mortars, and one battery of two 5-inch rapid-fire guns.

The battery of six 10-inch and 12-inch disappearing guns is practically completed. The three 10-inch guns are mounted in position, and the three 12-inch guns can be mounted as soon as the guns and carriages are received. The six emplacements contain, all told, 37,524 cubic yards of concrete masonry and 20,970 cubic yards of earth and sand embankment. The work still to be done consists in building a parados and a road in rear of the battery; in completing the installation of the systems for electric lighting and for the service of ammunition, and in finishing up minor details about the work. All materials necessary are on hand and no delays are anticipated. The total cost of this battery, up to June 30, 1897, was $231,338.40.

The only work done during the fiscal year on the construction of the battery for three 12-inch guns on disappearing carriages was the driving of 772 piles, practically completing the pile foundations, 4,582 piles in all having been driven. Everything is in readiness to carry on rapidly

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the construction of the battery proper as soon as funds are available. Up to June 30, 1897, $132,493.44 had been expended on this battery.

With funds appropriated in the act of March 3, 1897, it is proposed to construct a battery of sixteen 12-inch mortars. The allotment for this work was made early in June. An extension to the wharf leading to the site is now in course of construction; specifications have been issued for the principal building materials needed, and arrangements made to set up the construction plant. It is believed that work on the battery itself can be begun in a few weeks.

Two emplacements for 5-inch rapid-fire guns on balanced pillar mountings are to be built near to, and from the allotment for, the six-gun battery. The project for the two emplacements was approved early in June; excavation for the foundations began at once and is now nearly completed. It is estimated that the two emplacements will be ready to have the guns mounted in them by August 15, 1897.

(See Appendix 3 G.)

Defenses of Baltimore, Md.—Officer in charge, Col. Peter C. Hains, Corps of Engineers, with Lieut. Charles W. Kutz, Corps of Engineers, under his immediate orders since October 2, 1896.

During the past year three sites were acquired by condemnation proceedings. In addition there are two old works, one garrisoned and one under the care of a watchman.

Under the authority granted to the Secretary of War by the act of June 6, 1896, gun and mortar batteries of modern types are under construction by contract at two of the new sites. The third new site is under the care of a watchman, there being no funds available for the battery proposed to be constructed there.

Operations of the year consisted in the commencement of a battery for eight 12-inch mortars, which is to be supplemented by emplacements for two 5-inch rapid-fire guns; also one emplacement for 12-inch rifle and three emplacements for 8-inch rifles, all with disappearing carriages. At the close of the fiscal year operations at the two sites were well under way, with complete working plants and a large variety of constructing material. Work is being pushed with vigor, and it is hoped that all the contracts will near completion at the expiration of the contract time, which is in the autumn of 1897.

The sea is encroaching on the sites of the works of defense, and the shore lines should be protected by sea walls similar to the one completed at Fort McHenry. The shore line at one site, which needed immediate care, is being partially protected with riprap stone. The funds were derived from the appropriation for preservation and repair of fortifications, but are inadequate for what is required.

The two old works are a part of the revised project for defense, but no funds are yet available for operations. In the meantime small repairs have been made with funds derived from the appropriation for preservation and repair of fortifications, and the shore line of one protected by the completion of a sea wall begun many years ago.

(See Appendix 3 H.)

Defenses of Washington, D. C.—Officer in charge, Lieut. Col. Charles J. Allen, Corps of Engineers; assistants, Lieut. George P. Howell, Corps of Engineers, to July 8, 1896, and Lieut. Jay J. Morrow, Corps of Engineers, since September 8, 1896.

At the close of the previous fiscal year the modern defenses consisted of two emplacements for 10-inch guns on disappearing carriages practically completed, but without armament. These were finished

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in all respects and their armament placed in position during the fiscal year.

With funds from the act of June 6, 1896, one emplacement for 10-inch gun was commenced and entirely completed and armed during the fiscal year. A fourth emplacement for 10-inch gun on disappearing carriage was commenced with funds from the act of March 3, 1897.

Under authority granted the Secretary of War by the act of June 6, 1896, a contract was entered into for the construction of three emplacements for 8-inch guns on disappearing carriages. At the close of the fiscal year all necessary preliminary work, including the construction of a wharf, had been completed and most of the excavation finished.

(See Appendix 3 I.)

Defenses of Hampton Roads, Va.—Officer in charge, Capt. Thomas L. Casey, Corps of Engineers, with Lieut. Charles W. Kutz, Corps of Engineers, under his immediate orders until October 1, 1896; Division Engineer, Col. Peter C. Hains, Corps of Engineers.

The three emplacements for 10-inch guns on disappearing carriages mentioned in the last Annual Report were completed in most of their minor details and their armament put in position by artillery troops. The mortar battery for sixteen 12-inch mortars which had been commenced during the previous fiscal year has progressed in a satisfactory manner. Practically all the masonry is completed, 20,405 cubic yards of concrete having been placed during the year. A portion of the sand embankment is also in place. The platforms are all completed and have rings set. The carriages are being assembled by the artillery. With funds from the act of March 3, 1897, it is proposed to construct one emplacement for 10-inch gun on disappearing carriage. The plans for this work were in course of preparation at the close of the year.

The sewerage system, with flushing arrangement complete, was turned over to the post quartermaster for operation and maintenance on September 1, 1896, in accordance with authority from the Secretary of War.

(See Appendix 3 J.)

Defenses of coast of North Carolina.—Officers in charge, Lieut. Col. David P. Heap, Corps of Engineers, to March 12, 1897, and Capt. William E. Craighill, Corps of Engineers, after that date; assistant, Lieut. Edgar Jadwin, Corps of Engineers; Division Engineer, Col. Peter C. Hains, Corps of Engineers, since March 13, 1897.

The works consist of three forts of the old type, which are in bad repair, owing to lack of funds for their preservation. One of them, the battery at Fort Johnston, antedates the war of 1812, and has disappeared, except some remains of the sea wall.

Under authority granted the Secretary of War in the act of June 6, 1896, a contract was made, dated December 9, 1896, for constructing three emplacements for 8-inch guns on disappearing carriages. Work on this battery was in progress at the close of the year. One emplacement is partly completed, the magazine well covered, and the platform in such a condition that it will be ready to receive its gun carriage by about August 1. But little has been done on the second and third emplacements. The contract requires the whole work to be completed before December 1, 1897, but it is doubtful whether this will be accomplished.

(See Appendix 3 K.)

Defenses of coast of South Carolina.—Officer in charge, Capt. Frederic V. Abbot, Corps of Engineers, with Lieut. Edwin R. Stuart, Corps of Engineers, under his immediate orders since September 30, 1896; Division Engineer, Col. Peter C. Hains, Corps of Engineers.

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These consist of four works of older type, three of which are in charge of ordnance sergeants, and the fourth of the Light-House Establishment, being used as a supply depot.

The modern defenses consist of a mortar battery for sixteen 12-inch mortars and a gun battery for three 10-inch guns on disappearing carriages. The mortar battery is being built by hired labor, partly with funds from the act of June 6, 1896, and partly with balances from earlier appropriations. The total expenditures to June 30, 1897, were $178,334.51. The gun battery is being built by contract under the act of June 6, 1896. At the close of the fiscal year the mortar battery was completed, except the floors and drainage system, and sixteen carriages and eight motars were mounted. Excellent progress has been made by the contractors for the gun battery, and at the close of the fiscal year the work was about six-tenths completed, with every prospect of its being finished before the close of the present working season. The total expenditures to June 30, 1897, were $60,100.24.

During the year the United States obtained title to all lands for sites of the 10-inch gun battery and for a proposed 12-inch gun battery, except four lots, which were condemned, and of which the papers are awaiting the opinion of the Attorney-General. The expenditure for sites has been $52,361.11.

(See Appendix 3 L.)

Defenses of coast of Georgia and Cumberland Sound.—Officer in charge, Capt. Oberlin M. Carter, Corps of Engineers; Division Engineer, Col. Peter C. Hains, Corps of Engineers.

These consist of three fortifications of the older type and a battery of four 8-inch guns on disappearing carriages. The older works are ungarrisoned, two of them being in charge of ordnance sergeants. They are all in bad condition and in need of extensive repairs.

Under authority granted the Secretary of War by the act of June 6, 1896, contracts were entered into for the construction of a wharf and for four emplacements for 8-inch guns on disappearing carriages. At the close of the fiscal year the wharf had been completed, the battery site cleared, a working plant installed, and the excavation partly completed. The progress of the battery contract has not been satisfactory.

(See Appendix 3 M.)

Defenses of coast of Florida.—Officer in charge, Lieut. Col. William H. H. Benyaurd, Corps of Engineers; assistants, Lieut. James J. Meyler, Corps of Engineers, until February 19, 1897, and Lieut. Robert P. Johnston, Corps of Engineers, since September 15, 1896.

These consist of three works of the older type with their outlying batteries. One of them, Fort Marion, St. Augustine, is of little value for defensive purposes. It is a most interesting relic of the Spanish invasion of America, and has been cared for and preserved as such. The other works, situated on the Florida Keys, are of considerable strength, and will bear a prominent part in the defense of the Gulf of Mexico. Neither is garrisoned. One is cared for by an ordnance sergeant and a fort keeper, and one is now in charge of the Marine-Hospital Service and used as an outer quarantine station. With the exception of woodwork, which is badly decayed, both are in as fair a state of preservation as could be expected with the limited amounts available in recent years for the preservation of fortifications. Large sums could be expended on both advantageously.

Under authority granted the Secretary of War in the act of June 6, 1896, plans and specifications for emplacements for four 10-inch and two 8-inch guns on disappearing carriages and eight 12-inch mortars were

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prepared, bids invited by advertisement, and a contract entered into involving an expenditure of about $400,000, which amount was allotted from funds appropriated in the act of March 3, 1897. These emplacements are to be completed by January 1, 1898.

The construction of a mining casemate and cable gallery was commenced during the year.

Negotiations were had with a view to the purchase of additional sites for fortifications.

(See Appendix 3 N.)

Defenses of Pensacola, Fla.—Officer in charge, Maj. Frederick A. Mahan, Corps of Engineers; assistant, Lieut. James P. Jervey, Corps of Engineers; Division Engineer, Col. Peter C. Hains, Corps of Engineers.

These defenses consist of one battery for four 10-inch high-power guns mounted on disappearing carriages, and of two works of the older type with their outlying batteries. One of the latter is garrisoned by artillery troops. Both are required for the defense.

The principal work during the year has been the construction of the battery for four 10-inch high-power guns on disappearing carriages. Two of these were built under allotments made from the appropriation for gun and mortar batteries, act of June 6, 1896, and the remaining two under earlier appropriations. The emplacements are ready for their armament. Three concrete platforms, with granite pintle blocks for 8-inch converted rifles, were built to replace three timber platforms which had become so rotten as to be useless.

Under the act of March 3, 1897, a mortar battery for eight 12-inch mortars will be constructed. At the close of the year the plans for this battery had been approved and the preliminary construction work commenced.

(See Appendix 3 O.)

Defenses of Mobile and Mississippi Sound.—Officer in charge, Maj. William T. Rossell, Corps of Engineers; assistants, Lieut. Harry Burgess, Corps of Engineers, to September 24, 1896, and Lieut. James B. Cavanaugh, Corps of Engineers, since September 27, 1896; Division Engineer, Col. Peter C. Hains, Corps of Engineers.

These defenses consist of three works of the older type. They are not garrisoned, and are cared for by two ordnance sergeants and civilian employees. All occupy important sites, but are in bad condition.

During the fiscal year 5,000 feet of riprap sea wall and 3,350 feet of fence were constructed for the preservation of these works.

The most important operations of the year consisted in the completion of the first emplacement of a four-gun battery for 8-inch rifles, the construction of the second emplacement and two platforms, and the partial construction of the two remaining emplacements and platforms. The first two emplacements have been ready for their armament some time; the second two will be ready in a few weeks, and the battery completed so far as funds available permit.

The total amount expended on the battery to July 1, 1897, is $153,698.40. Three of these emplacements were built with funds from the act of June 6, 1896, and the remaining one from earlier appropriations.

(See Appendix 3 P.)

Defenses of New Orleans, La.—Officers in charge, Maj. James B. Quinn, Corps of Engineers, to September 15, 1896, and since June 14, 1897; Lieut. Charles S. Riché, Corps of Engineers, from September 15, 1896, to June 14, 1897; Division Engineer, Col. John W. Barlow, Corps

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of Engineers, until May 7, 1897; Col. Henry M. Robert, Corps of Engineers, after that date.

These include a number of the older type of works. Two forts and their outlying batteries are embraced in the modern scheme of defense. None of them are garrisoned, but three are in charge of ordnance sergeants.

Work was continued throughout the year upon a battery for two 10-inch guns on disappearing carriages. This battery is being built partly with funds from the act of June 6, 1896, and partly from earlier appropriations. Owing to the nature of the soil, considerable settlement has occurred and has prevented the completion of all the details of the platforms. These details will be finished as soon as the emplacements come to a bearing.

With funds from the act of March 3, 1897, two emplacements for 8-inch guns on disappearing carriages will be constructed. At the close of the year the plans for this work had been approved and funds allotted.

(See Appendix 3 Q.)

Defenses of Galveston, Tex.—Officers in charge, Maj. Alexander M. Miller, Corps of Engineers; assistants, Lieut. William V. Judson, Corps of Engineers, to February 25, 1897, and Lieut. Charles S. Riché, Corps of Engineers, since June 20, 1897; Division Engineer, Col. John W. Barlow, Corps of Engineers, to May 11, 1897, and Col. Henry M. Robert, Corps of Engineers, after that date.

There are no old-type fortifications at Galveston.

The following new-type works have been authorized: Emplacements for two 10-inch guns on disappearing carriages, emplacements for eight 12-inch mortars, and a mining casemate.

The construction of mining casemate was begun June 26, 1896, the body was completed July 28, the gallery on October 9, the mound covering on January 18, 1897, and the casemate was finally completed on June 30. The total cost was $15,009.27.

With funds from the act of June 6, 1896, work was commenced on the construction, by hired labor, of two emplacements for 10-inch guns on disappearing carriages on November 23, 1896. It was expected that they would be completed by the end of the present fiscal year, but this was found to be impossible, owing to delays in procuring plant with which to carry on the work, and in constructing a railway track and trestle to the site for the transportation of material. The concrete work was, however, nearly completed, and it is expected that the battery will be finished by August 31, 1897. The amount expended to date on this battery has been $79,702.15.

Under authority granted by the act of June 6, 1896, a contract was entered into December 15, 1896, for constructing emplacements for the eight 12-inch mortars. Actual work was not commenced until February 20, 1897. The progress has not been as rapid as was hoped for, principally due to the fact that this kind of work was an entirely new experience for contractors in this section of the country, and because what work had been done up to March 28, 1897, was almost entirely swept away by a severe storm which occurred on that date. At the close of the year the mortar platforms had been completed and were ready to receive the iron work, and the foundations of part of the walls had been laid. The amount expended to June 30, 1897, was $9,374.56.

A site was purchased at a cost of $35,000 upon which to build

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fortifications, and negotiations were going on looking to the purchase of a second site at a cost of $36,000 for the same purpose.

(See Appendix 3 R.)

Defenses of lake ports in New York.—Officer in charge, Maj. William S. Stanton, Corps of Engineers; Division Engineer, Col. (now Brig. Gen.) John M. Wilson, Corps of Engineers, until February 11, 1897, and Col. George L. Gillespie, Corps of Engineers, after that date.

These consist of three works of older type, one garrisoned and the others in charge of ordnance sergeants. Minor repairs have been made to these works during the year, as far as the limited funds would permit. Work was commenced during the year upon the protection of the site of Fort Niagara, which was being eroded along the river bank for a length of 1,800 feet. It is expected that this work will be completed during the present season.

A project has been prepared and has received the approval of the Secretary of War for the defense of Lake Champlain.

(See Appendix 3 S.)

Defenses of San Diego, islands in San Francisco Bay, and north side of San Francisco Bay, California.—Officer in charge, Maj. Charles E. L. B. Davis, Corps of Engineers; assistants, Lieut. Charles L. Potter, Corps of Engineers, to September 5, 1896, and Lieut. Herbert Deakyne, Corps of Engineers, since September 14, 1896; Division Engineer, Col. Charles R. Suter, Corps of Engineers.

Under authority granted by the act of June 6, 1896, a contract was entered into for the construction of two emplacements for 10-inch guns on disappearing carriages at San Diego, Cal. At the close of the year one emplacement was practically completed and the other about two-thirds done. With funds from the act of March 3, 1897, a third 10-inch emplacement is to be constructed by contract. At the close of the year the plans for this work had been approved and specifications were being prepared with a view to advertising for proposals.

During the year title was obtained to a needed site for a mortar battery.

At San Francisco three emplacements for 12-inch guns on barbette carriages were completed so far as could be prior to the mounting of the guns and carriages. Two guns and carriages were mounted at the close of the year, and the third gun and carriage were being placed in position. These emplacements will be entirely finished during the present season.

With funds from the act of March 3, 1897, a mining casemate is being constructed at San Diego and one at San Francisco.

(See Appendix 3 T.)

Defenses of San Francisco, Cal., on south side of bay.—Officer in charge, Col. Charles R. Suter, Corps of Engineers; assistants, Capt. Joseph E. Kuhn, Corps of Engineers, to July 26, 1896, and Lieut. Charles L. Potter, Corps of Engineers, since September 5, 1896.

These defenses consist of two old type works, and of modern batteries for 12-inch and 10-inch rifles, dynamite guns, and rifled mortars.

Three emplacements for 12-inch guns on nondisappearing carriages had been substantially completed at the end of last fiscal year, also three emplacements for 10-inch guns on disappearing carriages, one mortar battery for sixteen 12-inch rifled mortars, and a battery of three 15-inch dynamite guns. During the past year two emplacements for 12-inch rifles on nondisappearing carriages have been built, and one emplacement for a 12-inch rifle on disappearing carriage. On the older works considerable work has been done in replacing macadam

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terrepleins by concrete pavements, building guard and relocator rooms, introducing ammunition conveyors, etc., and an efficient water service for the batteries has been installed.

Two 12-inch and two 10-inch rifles have been mounted during the year.

The three earlier 12-inch emplacements, the mortar battery, and the dynamite-gun battery are in charge of the commanding officer of the Presidio.

With funds appropriated in the act of March 3, 1897, it is proposed to construct emplacements for two 10-inch disappearing guns and sixteen 12-inch rifled mortars. The emplacements for two rapid-fire guns, provided for under last year's appropriation, will also be built.

(See Appendix 3 U.)

Defenses of mouth of Columbia River.—Officer in charge, Capt. Walter L. Fisk, Corps of Engineers, with Lieut. Clement A. F. Flagler, Corps of Engineers, under his immediate orders; Division Engineer, Col. Charles R. Suter, Corps of Engineers.

The defenses include two works of older type, one garrisoned and one in charge of an ordnance sergeant.

With funds appropriated by the act of June 6, 1896, work was commenced during the fiscal year on five emplacements for 10-inch guns on disappearing carriages, two emplacements for 8-inch guns on disappearing carriages, and on two mining casemates.

At the close of the year the 10-inch emplacements were completed and three 10-inch carriages mounted. A wharf had been built for the construction of the 8-inch emplacements, all necessary plant assembled, and the excavation completed. One mining casemate was also under construction.

With funds appropriated by the act of March 3, 1897, an additional emplacement for 8-inch gun on disappearing carriage and a mortar battery for eight 12-inch mortars will be constructed. At the close of the year plans for these works had been partially prepared.

(See Appendix 3 V.)

Defenses of Puget Sound.—Officer in charge, Capt. Harry Taylor, Corps of Engineers, with Lieut. Meriwether L. Walker, Corps of Engineers, under his immediate orders since January 15, 1897; Division Engineer, Col. Charles R. Suter, Corps of Engineers.

There are no existing works of defense on Puget Sound. During the year title was obtained to two of the sites needed for defensive works, and negotiations are in progress for the acquisition of a third site. The failure to attain these sites as early as desired has seriously delayed the progress of construction work.

Under authority granted by the act of June 6, 1896, two emplacements for 12-inch guns and four emplacements for 10-inch guns, all on nondisappearing carriages, will be constructed by contract on one of the sites obtained during the year. At the close of the year the plans for these emplacements had been approved, the work advertised, and bids opened on June 30, 1897. Emplacements for four 10-inch guns on disappearing carriages will also be built by contract, under the act of June 6, 1896, on a second site obtained during the year. The plans for this work have been approved and advertisements issued on June 23, 1897.

As soon as title can be obtained to the needed site it is proposed to construct a mining casemate with funds appropriated by the act of March 3, 1897.

(See Appendix 3 W.)

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ESTIMATES OF APPROPRIATIONS REQUIRED FOR 1898-99.

Fortifications.

For gun and mortar batteries	$5,000,000
For purchase of land for fortifications	500,000
For protection, preservation, and repair of fortifications	100,000
For preparation of plans for fortifications	5,000
For sea walls and embankments	55,000
For torpedoes for harbor defense: For the purchase of submarine mines, and necessary appliances to operate them, for closing the channels leading to our principal seaports; for needful casemates, cable galleries, etc., to render it possible to operate submarine mines	150,000
Total	5,810,000

Engineer Depot at Willets Point, N. Y.

For incidental expenses of depot	5,000
For purchase of materials for use of United States Engineer School and for instruction of battalion	1,500
For purchase and repair of instruments	3,000
For purchase and binding of professional works for library of United States Engineer School	500
For construction of a fireproof instrument-repair shop	8,000
For completion of a reserve train of bridge equipage	18,000
For construction of a machine shop and for purchase of necessary tools	5,000
Total	41,000

RIVER AND HARBOR IMPROVEMENTS.

The funds with which the works for the improvement of rivers and harbors were prosecuted during the last fiscal year were derived from the appropriations made by the urgent deficiency act approved February 26, 1896, and sundry civil act approved June 11, 1896, for certain works the completion of which had been authorized by laws of September 19, 1890, and July 13, 1892, and from balances of former appropriations as were available. On June 3, 1896, a river and harbor act became a law, appropriating $12,634,550 for works of improvement and for surveys and examinations. This law also authorized the incurring of liabilities for the completion of a number of works.

Statements derived from the reports of the officers in charge of the several works and given herewith set forth the condition of each improvement and the extent of the work performed during the last fiscal year. Further appropriations for works of river and harbor improvements were made by the sundry civil act approved June 4, 1897, and the deficiency act approved July 19, 1897.

Experience has shown that the system of providing funds for carrying on continuously or the completion of certain works has heretofore resulted in materially reducing cost and in granting benefits to commerce within reasonable periods, and if this system is restricted to works fully justified by the interests of commerce involved it will prove an economical one, provided appropriations are so made as to avoid delays in payment to contractors. The act of 1896, in providing for the completion of certain works, extends the payments for such work over several years, with the thought, possibly, that contractors would be willing to carry such works to completion rapidly, awaiting action of Congress for payment, but such result can not be assured, and in most cases, while the continuing contracts result, as a rule, in greatly reduced prices, the time of completion remains a function of the rate of appropriation of funds. The disadvantage which may result from

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such continuous contracts is the necessity for planning in all detail in a very limited time the work of many years in advance, which may interfere with such modifications of plan as continued experience may dictate to be most desirable.

The total expenditure for the improvement of rivers and harbors during the fiscal year ending June 30, 1897, exclusive of the work of the Mississippi River and Missouri River Commissions, was	$11,478,093.15
For work under the Mississippi River Commission	1,595,975.98
For work under the Missouri River Commission	387,326.39
Total	13,461,395.52

The total estimate submitted by the Chief of Engineers for 1899 for continuous work authorized by Congress is $18,098,007.56.

For the construction and maintenance of works authorized by Congress, but not provided for by continuing contracts, estimates amounting to $30,630,153 are presented.

Under the provisions of law the operating, care, and maintenance of certain public works is provided for by an indefinite appropriation of July 5, 1884.

A large number of the works which have been constructed by the authority of Congress, and which can not be maintained under the indefinite appropriation, require annual expenditures for repairs and renewals if they are to be kept in a state of efficiency. Under the expressed authority of Congress estimates are presented for some of these works, but as other works equally worthy can not now be so provided for it is recommended that general authority be granted the Chief of Engineers to present such estimates for works whose maintenance is considered necessary in the interest of commerce and navigation.

Section 6 of the river and harbor act of 1888 provides funds for gauging the waters of the Mississippi River and its principal tributaries by an indefinite appropriation of $6,000 annually.

The sum of $25,000 annually is also made available by the act of August 11, 1888, for operating snag boats and dredge boats on Upper Mississippi River.

By act of August 11, 1888, the sum of $100,000 is made available annually for work of removing snags and wrecks from Mississippi River.

By act of September 19, 1890, as amended by act of June 3, 1896, $50,000 annually is appropriated for operating snag boats on Ohio River.

Reports are appended of work accomplished in the removal of wrecks obstructing or endangering navigation, as provided for in section 4 of the river and harbor act approved June 14, 1880, and enlarged by provision in the river and harbor act of August 2, 1882.

Under the authority given to the Secretary of War in section 12 of the river and harbor act approved September 19, 1890, harbor lines have been established during the past fiscal year at the following localities, details of which will be found in the local officers' reports: Charles River, at Cambridge, Mass.; Bridgeport Harbor, Connecticut; Ellis Island, New York Harbor, New York; Harlem River and Spuyten Duyvil Creek, from eastern end of Dyckmans Creek to the western end of Dyckmans Creek, New York; Hudson River, New York, (1) from West Twenty-third street to West Eighty-first street, New York City; (2) from Battery Place to West Twenty-third street, New York City, and from Morris Canal Basin to abreast of Bulls Ferry, New Jersey; East River, near East Eighty-ninth street, New York City; Ashley and Cooper rivers, at Charleston, S. C.; Superior and

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Allouez bays, at Duluth and Superior Harbor, Minnesota and Wisconsin; Kewaunee Harbor, Wisconsin; Waukegan Harbor, Illinois; Erie Harbor, Pennsylvania, and Olympia Harbor, Washington.

Examinations were made during the year, whenever required by the committees of Congress, of bills authorizing the construction of bridges and for other purposes upon which the views of the War Department were desired.

The river and harbor act of June 3, 1896, ordered an examination made of the Bartrand River, South Carolina. Diligent search and inquiry has failed to show where such river is located, and it has been impracticable to make the examination.

During the fiscal year examinations were made of such plans and locations as were submitted by parties interested of bridges proposed to be built over navigable waters subject to the approval of the Secretary of War. A brief statement is given of the action had in such cases.

Under sections 4 and 5 of the river and harbor act approved September 19, 1890, persons, corporations, or associations owning or controlling bridges over navigable waterways of the United States which are unreasonable obstructions to the free navigation of such waters, after being given a reasonable opportunity to be heard, have been notified to so alter the bridges as to render navigation through or under them reasonably free, easy, and unobstructed. In each case the changes required to be made were specified in the notice, and reasonable time was prescribed in which to make them. A detailed statement of the cases is given farther on in this report.

Reports made in compliance with the requirements of section 2 of the river and harbor act of July 5, 1884, and section 4 of that of August 5, 1886, of instances in which piers, breakwaters, or other works built by the United States in aid of commerce or navigation are used, occupied, or injured by a corporation or an individual will be found in Appendix Y Y.

The river and harbor act of June 3, 1896, required the compilation of all general laws that have been enacted from time to time by Congress for the maintenance, protection, and preservation of the navigable waters of the United States, and the submission of such compilation to Congress at its session in December, 1896.

Such compilation was presented to Congress and printed as House Doc. No. 293, Fifty-fourth Congress, second session. It is also submitted herewith as Appendix E E E.

The act also required the submission to the Fifty-fifth Congress at its first session a compilation with full details of all preliminary examinations and surveys heretofore made, a complete list with details of all projects now being carried out, and certain details as to expenditures for rivers and harbors.

This work, which has been under way since the passage of the law, has proved most laborious. The results will be presented to Congress at the earliest date practicable at its next session.

Results most favorable to the interests of commerce have continued to follow the improvements carried on under officers of the Corps of Engineers.

(*a*) At Charleston, S. C., where originally channels were crooked, with a maximum depth of 12 feet, there is now a depth at mean low water of 21 feet and high-tide depth of 25.9 feet, except for a very short distance, where low-tide depth is 19 feet, and the channel is continually improving.

(*b*) At Galveston, Tex., where originally there were depths of 9.5

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and 12 feet on the inner and outer bars, there are now corresponding depths of 25.5 and 24.75 feet, with improvement still going on.

(*c*) At the mouth of the Columbia an originally changeable channel with depth of from 19 to 21 feet has been so improved as to give at the present time in a comparatively fixed location a depth of 30 feet over a width of 2,000 feet.

(*d*) At Wilmington, Cal., where, in 1871, there was a depth at the entrance of less than 2 feet, there is now a depth of 14.5 feet at mean low water, admitting vessels of over 20 feet draft at high tide.

(*e*) In the ship channel connecting the waters of the Great Lakes between Chicago, Duluth, and Buffalo, depths of 20 and 21 feet have been obtained over areas where there was an available depth of about 16 feet when this general project of improvement was adopted, this depth of 16 feet having been secured by successive improvements of several localities where the original depth had been from 6 to 10 or 12 feet only.

Obstruction of navigable Southern rivers by the aquatic plant known as the water hyacinth.—The sundry civil act approved June 4, 1897, made provision for the investigation of the obstruction of the navigable waters of Florida, Louisiana, and other South Atlantic and Gulf States by an aquatic plant known as the water hyacinth, and authorizes such experiments as may be deemed necessary to determine some suitable and feasible plan or method of checking and removing such obstacles so far as it is a hindrance to interstate and foreign commerce.

For the purpose of considering the question demanding attention under this provision of law, a Board of Officers consisting of Lieut. Col. W. H. H. Benyaurd and Maj. James B. Quinn, Corps of Engineers, was constituted by authority of the Secretary of War to give the matter such consideration as is possible with the limited funds provided.

This Board held a preliminary meeting at St. Augustine, Fla., August 5, 1897, and after some discussion of the very limited data available it adjourned to await the preparation of further information deemed important in connection with the subject in hand, and it will reconvene at the earliest day practicable, it being desired that the report, if possible, be presented to Congress at its next session.

The engineering works in the charge of this office are arranged in five divisions, and officers of the Corps of Engineers assigned as division engineers to overlook the works as follows:

West of the Rocky Mountains: Pacific Division, Col. Chas. R. Suter. East of the Rocky Mountains: Northeast Division, Col. (now Brig. Gen.) John M. Wilson to February 11, 1897, and Col. G. L. Gillespie since February 11, 1897; Southeast Division, Col. Peter C. Hains; Southwest Division, Col. J. W. Barlow to May 7, 1897, and Col. Henry M. Robert since May 7, 1897; Northwest Division, Col. Henry M. Robert to May 7, 1897, and Col. J. W. Barlow since May 7, 1897.

South Pass of the Mississippi River.—During the year the required channel was maintained through the shoal at the head of South Pass and through the pass itself, except during thirty-seven days when the channel in Grand Bayou Reach did not contain the required depth.

The required channel "through the jetties" and beyond them to deeper water in the Gulf was maintained during the year except for one hundred and thirty-seven days.

I desire to call special attention to the necessity for legislation to afford much needed relief to employees who may be injured or disabled while engaged upon public works under control of this Department, which are often carried on in remote localities where access to physicians and surgeons is not readily had. In the prosecution of work

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requiring the use of complicated machinery and of high explosives in large quantities, accidents of a nature more or less serious are bound to occur, due in some instances to carelessness of the injured or of some other employee, or the accident may be unavoidable, which is true undoubtedly in a large majority of cases. In any event, common humanity demands that the injured man shall be conveyed, without loss of time and with as little suffering as possible, to some place where medical treatment may be had. In recognition of this natural claim for attention, some of the officers in charge of work where accidents of a serious nature have occurred, involving intense physical suffering and in some cases loss of limb, have promptly taken measures for the care of the injured; but the Comptroller has decided that expenditures for such purposes can not be passed to the credit of the disbursing officer, and his only recourse has been to Congress for a special act for his relief.

Some action, it seems to me, is necessary on the part of Congress to place it within the power of the Secretary of War to authorize expenditures of a reasonable amount in extending aid to employees injured while in the employ of the United States, and I earnestly recommend that the subject receive careful consideration and such favorable action as in the judgment of Congress may be deemed equitable.

ATLANTIC COAST AND GULF OF MEXICO.

IMPROVEMENT OF RIVERS AND HARBORS IN MAINE AND NEW HAMPSHIRE.

This district was in the charge of Lieut. Col. A. N. Damrell, Corps of Engineers, to April 27, 1897, and of Maj. R. L. Hoxie, Corps of Engineers, since that date, these officers having under their immediate orders Lieut. George P. Howell, Corps of Engineers, since July 13, 1896. Division Engineer, Col. G. L. Gillespie, Corps of Engineers, since April 30, 1897.

1. Lubec Channel, Maine.—This channel lies between the eastern extremity of the State of Maine and Campobello Island, Dominion of Canada.

Originally the channel was but 5 feet in depth at mean low tide, and but 2 feet at low water of spring tides. A project was adopted in 1879 which as subsequently modified provided for a channel 275 feet wide, increasing to 300 feet in the bends, and 12 feet deep at mean low tide. This project was completed in 1890, practically as proposed, at a cost of $168,954.68. In 1894 a new project was adopted which provided for widening the existing channel to a least width of 500 feet, with a depth of 12 feet at mean low tide. The work covered by the new project has been estimated to cost $150,000.

The expenditures to June 30, 1896, amounted to $191,838.93 ($168,954.68 on the old project and $22,884.25 on the new). At that date the channel dredged under the project of 1879 had been widened about 170 feet at the entrance and about 100 feet at the turn just above Cranberry Point.

The expenditures during the fiscal year ending June 30, 1897, amounted to $16,982.51. The operations consisted in dredging under a contract completed July 21, 1896. The total quantity of material dredged was 120,000 cubic yards, about 100,000 cubic yards of which had been removed during the previous fiscal year. The channel was widened about 170 feet at the entrance, and about 150 feet at the turn just above Cranberry Point.

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The improvements render less difficult the passage of a way which is subject to strong currents and frequent fogs.

The commerce of this channel not being local, it is impracticable to state definitely the character and quantity. The local tonnage is given as 52,300 tons. It is estimated by the deputy collector of customs that about 2,000 vessels of all classes passed through the channel or came in for refuge during 1896.

July 1, 1896, balance unexpended		$49,161.07
June 30, 1897, amount expended during fiscal year		16,982.51
July 1, 1897, balance unexpended		32,178.56
July 1, 1897, outstanding liabilities	$150.00	
July 1, 1897, amount covered by uncompleted contracts	29,000.00	
		29,150.00
July 1, 1897, balance available		3,028.56
Amount (estimated) required for completion of existing project		78,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		40,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix A 1.)

2. Moosabec Bar, Maine.—Before improvement the entrance at the eastern end of Moosabec Reach was difficult, the channel being crooked, with ledges on either hand. The direct entrance was obstructed by a bar on which the depth was less than 6 feet at mean low tide.

A project adopted in 1881 provided for a channel 14 feet deep at mean low tide and not less than 200 feet wide through the bar at the eastern entrance to the reach. October 30, 1888, this project was amended to cover the widening of the 14-foot channel to 300 feet, the removal of ledges obstructing the channel, and the construction of a small breakwater to divert cross currents. The estimated cost of the project is $114,000.

The expenditures to June 30, 1896, amounted to $87,908.65. At that date the 300-foot channel had been completed, the breakwater had been built, and 1,940 cubic yards of ledge had been removed.

The expenditures during the past year amounted to $60.42. Operations were suspended until early in June, 1897, when the removal of ledge in the western approach to the channel was resumed under a partly completed contract. Though some work was done, no material had been actually taken up at the close of the fiscal year. About 187 cubic yards of ledge is to be removed under the contract referred to, and about 760 cubic yards more under a contract made May 22, 1897.

The commerce benefited is not local, the reach being extensively used by coastwise vessels both as a harbor of refuge and a sheltered route. It has been estimated that about 2,000 vessels, carrying 275,000 tons of freight, passed through the reach.

July 1, 1896, balance unexpended		$15,091.35
June 30, 1897, amount expended during fiscal year		60.42
July 1, 1897, balance unexpended		15,030.93
July 1, 1897, outstanding liabilities	$431.03	
July 1, 1897, amount covered by uncompleted contracts	12,969.72	
		13,400.75
July 1, 1897, balance available		1,630.18
Amount (estimated) required for completion of existing project		11,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		11,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix A 2.)

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3. Narraguagus River, Maine.—The obstruction to navigation consisted in a bar at the mouth of the river, over which there was a navigable depth of less than 6 feet at mean low tide.

The project is to dredge a channel not less than 200 feet wide, having a depth of 11 feet at mean low tide up to Long Point, and a depth of 9 feet from thence to the anchorage, at an estimated cost of $50,000.

The expenditures to June 30, 1896, for improvements below Millbridge amounted to $39,731.83. At that date the channel had been dredged to the full width of 200 feet, up to the new steamboat wharf, and to a width of about 150 feet from thence to the old steamboat wharf, with a turning basin 300 feet wide in front of each wharf.

Dredging was commenced June 12, 1897, under a contract dated May 4, 1897, and at the close of the fiscal year 34,000 cubic yards of material had been removed, widening the channel between the wharves 50 feet, or to a width of 200 feet.

The tonnage for the year 1896 is given as 13,175 tons. The greatest single item is 10,500 tons of lumber.

July 1, 1896, balance unexpended	$5,268.17
June 30, 1897, amount expended during fiscal year	7.00
July 1, 1897, balance unexpended	5,261.17
July 1, 1897, outstanding liabilities	4,570.00
July 1, 1897, balance available	691.17
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	5,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix A 3.)

4. Breakwater from Mount Desert to Porcupine Island, Bar Harbor, Maine.—The anchorage in front of the town of Bar Harbor, as well as the wharves at which steamers land, is exposed to storms and seas from southerly directions, at times rendering the anchorage insecure and the landing of passengers and freight at the wharves difficult. The original project was to construct a riprap breakwater on a direct line from Porcupine Island to Dry Ledge, and thence to within a short distance of Mount Desert Island.

December 17, 1890, the Secretary of War approved a slight change in the direction of that portion west of Dry Ledge, the alteration bringing the westerly end of the breakwater somewhat farther to the southward.

In January, 1893, by authority of the Secretary of War the project was again amended, and now provides for a breakwater on the direct line first proposed, but somewhat shorter, terminating at a distance of about 600 feet from the low-water line on Mount Desert Island, and a further change has been suggested by which protection will be given to a larger area. The estimated cost of the present project is $420,200.

The expenditures to June 30, 1896, amounted to $159,348.30, completing the breakwater to a point 605 feet west of Dry Ledge.

The expenditure during the fiscal year 1897 was $10,107.67, making the total expenditures $169,455.97, and completing the structure for a distance of 666 feet west of Dry Ledge. The total projected length of that portion west of the ledge is 1,440 feet.

The traffic at this locality is chiefly the transportation of passengers and supplies. No statement of tonnage could be obtained.

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July 1, 1896, balance unexpended	$10,651.70
June 30, 1897, amount expended during fiscal year	10,107.67
July 1, 1897, balance unexpended	544.03
Amount (estimated) required for completion of existing project	250,200.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix A 4.)

5. Harbor at Sullivan Falls, Maine.—Sullivan River has a length of about 6 miles, and is the outlet of a large bay. About midway of its length a point of land projects to such extent as to reduce the width to about one-fourth that immediately above and below, and at this place the slope and velocity are such that the locality is termed Sullivan Falls. The bottom is ledge, the higher portions forming dangerous obstructions to navigation. Hatchers Rock, about midway of the narrow channel at the falls, had originally only about 6 inches of water over it at mean low tide.

Under a project completed in 1875, the sum of $35,000 was expended in removing three old piers, in excavating the obstructing ledges at the falls to a depth of 7 feet at mean low tide, and in placing spindles on two rocks near the mouth of the river. This work was of material benefit to navigation.

Under the act of 1890, an examination was made of Sullivan Falls, and a new project, estimated to cost $35,000, for removing Hatchers Rock and two other points of ledge to a depth of 10 feet at mean low tide was submitted. The first appropriation for work under this last project was by act of June 3, 1896. There were no expenditures during the fiscal year ending June 30, 1896, and no work was done.

There were no expenditures during the fiscal year 1897, and no work was done. A contract has, however, been made for removing, as far as funds will permit, the ledge known as Hatchers Rock, the work to be done during the present season.

The tonnage for 1896 is given as 51,200 tons, the principal items being 48,000 tons of granite and paving blocks.

July 1, 1896, balance unexpended	$5,000.00
July 1, 1897, amount covered by uncompleted contracts	4,500.00
July 1, 1897, balance available	500.00
Amount (estimated) required for completion of existing project	30,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix A 5.)

6. Union River, Maine.—Originally the channel of Union River was much obstructed, and in the upper part almost closed, at low tide. Under a project, completed in 1873, the sum of $30,000 was expended in removing a large quantity of mill waste, ledge, and bowlders, giving a depth of 3 to 4 feet at mean low tide up to the head of navigation at Ellsworth.

A survey of Union River and Bay was made under the act of 1888, and a project was submitted for obtaining a channel through the bar at the mouth of the river by the construction of a jetty, and for a depth of 6 feet at mean low tide in the upper part of the river by dredging. The total cost was estimated at $225,000, about $145,000 of which was for dredging. It was found that the channel was again filling with mill

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waste. The first appropriation since this survey was by the act of June 3, 1896, which appropriated $15,000 for improving Union River by dredging. There were no expenditures during the fiscal year ending June 30, 1896, and no work was done.

There were no expenditures during the fiscal year 1897, and no work was done. Proposals for dredging have been invited, the bids to be opened July 21, 1897.

The tonnage for 1896 is given as 54,000 tons, the principal item being 42,600 tons of lumber.

July 1, 1896, balance unexpended	$15,000.00
July 1, 1897, balance unexpended	15,000.00
Amount (estimated) required for completion of existing project	130,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix A 6.)

7. *Bagaduce River, Maine.*—This is a small stream that empties into Penobscot Bay at Castine, Maine. The upper part of the river divides into two branches, one called Northern Bay and the other South Bay. Northern Bay near South Penobscot is a shoal sheet of water of about 700 acres area, the bottom of which for the greater part is bare at low tide. There was a narrow channel from Bridges Point to Bowden's wharf which had a depth of less than 2 feet and was obstructed by ledges and bowlders near Winslows Island. The South Bay is obstructed by ledges at Johnsons Narrows. A project for the improvement of the Northern Bay was adopted in 1890, which has for its object the securing of a channel 100 feet wide and 6 feet deep at mean low tide from Bridges Point to Bowden's wharf, at an estimated cost of $45,000. It is also intended to remove a small quantity of rock obstructing the channel at Johnsons Narrows, at an estimated cost of $1,875.

The expenditures to the close of the fiscal year ending June 30, 1896, amounted to $16,995.34. The channel had been dredged its entire length for a width of 40 feet, but the full projected depth had not been obtained throughout. At Winslows Island, about midway of the channel and where it is shoalest, a depth of about 2 feet at mean low tide has been secured by the removal of bowlders.

Proposals for continuing the excavation of the channel with the available funds have been invited, the bids to be opened July 21, 1897.

The tonnage for 1896 is given as 78,000 tons, chiefly brick, grain, lumber, and lime. Probably not over one-fifth of this, however, passed through the improvement.

July 1, 1896, balance unexpended	$5,004.66
June 30, 1897, amount expended during fiscal year	29.50
July 1, 1897, balance unexpended	4,975.16
July 1, 1897, outstanding liabilities	25.00
July 1, 1897, balance available	4,950.16
Amount (estimated) required for completion of existing project	24,875.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	24,875.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix A 7.)

8. *Penobscot River, Maine.*—The improvement of the Penobscot River was first undertaken in 1870, the project being for a channel not less than 150 feet wide, 12 feet deep at low tide, as far up as Bangor. At

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that time the channel was shoal and dangerous. At Bangor the depth did not exceed about 6 feet at lowest stages, and navigation was obstructed by numerous rocks and ledges. The work was continued until 1880, and included also the removal of obstructions in the harbor at Bangor and at Bucksport, the expenditures aggregating $198,000. No further work was done until 1884, when a project was adopted for widening the channel at Bangor and for certain improvements in the river below, near Crosbys Narrows, at an estimated cost of $75,000. While this work was in progress a survey was made, under the river and harbor act of 1886, from Bangor to Bucksport Narrows, and a project was submitted for securing a 22-foot depth between Bucksport and Winterport, at an estimated cost of $365,000, making the combined cost of the two projects $440,000. The act of September 19, 1890, appropriated $25,000 and provided for dredging near Stern's mill.

Another survey was ordered in the act of September 19, 1890, which was made, and the report published in the Annual Report of the Chief of Engineers for 1892 (pp. 533–540).

The existing project for the improvement of the Penobscot River may be stated as follows: To widen the channel at Bangor to 360 feet and a depth of 11 feet at extreme low tide; to widen, straighten, and deepen the channel near Crosbys Narrows and near Stern's mill to a depth of 12 feet at extreme low tide, and to secure a channel depth of 22 feet at mean low tide between Bucksport and Winterport, the estimated cost of the entire work being $440,000. This estimate includes the cost of jetties at Frankfort Flats and High Head, in order to contract the waterway should contraction be necessary. It is thought, however, that as the deposit of sawdust and mill waste into the river has in a large measure been stopped, and as the channels at these places were obstructed chiefly by this material, the contraction works may not be necessary. The channel at Frankfort Flats was dredged in 1890 to 22 feet. Subsequently it filled up on the sides to some extent, the full depth in midchannel being maintained. A later survey showed that it had scoured out again, and that there existed a navigable channel not less than 500 feet wide and 22 feet or more in depth at low tide. As this is all the project contemplates, no further works of any kind are now proposed at Frankfort Flats.

The channel at High Head, which had deepened in 1891 from natural causes, subsequently filled up to some extent, so that it became advisable to dredge a channel the full depth and width called for by the project. This was done during the season of 1894.

An examination at both Frankfort Flats and High Head late in the season of 1896 showed that at Frankfort Flats there was a good channel not less than 300 feet wide, with a depth of not less than 22 feet at mean low tide. At High Head there was a break in the 22-foot contour for a distance of 500 feet. On the crest of this shoal the least depth was in excess of 19 feet at mean low tide.

No appropriation is asked for the improvement of the Penobscot River under the above project.

The appropriations up to the close of the fiscal year ending June 30, 1896, aggregated $348,300, and the expenditures under the various projects to the same date amounted to $337,936.12.

The results accomplished are the widening and deepening of the channel at Bangor from a depth of 6 feet at extreme low tide to 11 feet, for a width of 360 feet; the dredging of the shoal at Stern's mill to 12 feet, and of the shoal just below Stern's mill to the same depth; the removal of rocks, ledges, and other obstructions, the dredging of the

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shoals near Bucksport, and a general increase in depth and width of channels from the mouth up to Bangor.

The expenditures during the fiscal year 1897 amounted to $330.74. No work was done, the only operations consisting in an examination of work previously done in order to determine its condition.

The tonnage for the year 1896 is given as 715,911 tons, the principal items being 212,513 tons of coal, 161,000 tons of ice, and 187,609 tons of lumber.

July 1, 1896, balance unexpended	[1] $10,363.88
June 30, 1897, amount expended during fiscal year	330.74
July 1, 1897, balance unexpended	10,033.14
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	290,000.00

(See Appendix A 8.)

9. Belfast Harbor, Maine.—Originally the harbor was not deep enough to accommodate the commerce. At one place the depth was only about 4 feet at mean low tide.

In 1876 a project for dredging was adopted, and the work was completed in 1879, at a cost of $22,000. No more work was done until 1890, when a new project was adopted by which it was proposed to dredge a channel 250 to 300 feet wide and 15 feet deep at mean low tide from the deep water at the entrance up to the upper harbor; to dredge an area on the north side of the harbor to a depth of 8 feet, and to dredge an area on the south side of the channel to a depth of 13 feet.

The estimated cost of the latter project was $42,000.

The total expenditures up to June 30, 1896, amounted to $52,714.82. At that date the 8-foot dredging had been completed, the channel of entrance had been dredged to the full projected width and depth, and the area on the south side of the channel had been dredged for a width of about 320 feet.

The operations during the fiscal year consisted in dredging on the south side of the channel, where 50,506 cubic yards of material was removed during May and June, 1897, completing the project.

The tonnage for 1896 is given as 62,240 tons, the largest single item being 14,500 tons of coal.

July 1, 1896, balance unexpended	$8,285.18
June 30, 1897, amount expended during fiscal year	1,616.07
July 1, 1897, balance unexpended	6,669.11
July 1, 1897, outstanding liabilities	6,030.56
July 1, 1897, balance available	638.55

(See Appendix A 9.)

10. Camden Harbor, Maine.—Before the improvement under the existing project was commenced, vessels drawing more than 6 feet could not reach the wharves at low tide. The first project completed in 1876, at a cost of $30,000, was for regulating the entrance by dredging channels 100 feet wide and 7 feet deep at mean low tide, 1,500 feet long on the east side and 1,400 feet long on the west side.

The improvement projected at the present time is to dredge an area at the eastern part of the entrance to a depth of 12 feet at mean low

[1] Differs from last year's report by 59 cents, being amount of Treasury settlement for telegrams made in May, 1896.

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tide; to dredge a channel on each side of the harbor, and the approach to the same, to a depth of 10 feet at mean low tide; to dredge small channels at the upper end of the harbor to a depth of 5 feet at mean low tide; and after completion of the above, to dredge the middle ground of the harbor to the same depths as the adjacent channels.

The expenditures under the present project to the close of the fiscal year ending June 30, 1896, amounted to $34,638.78. As a result all the channels were practically finished, and about 500 feet of the middle ground, measured from the outer end, had been removed.

The expenditures during the fiscal year 1897 amounted to $10,048.17. During the latter part of the working season of 1896 there was dredged, under contract, 61,999 cubic yards of material, practically finishing the removal of the middle ground, and completing the project.

No statistics could be obtained.

July 1, 1896, balance unexpended	$10,361.22
June 30, 1897, amount expended during fiscal year	10,048.17
July 1, 1897, balance unexpended	313.05

(See Appendix A 10.)

11. Rockland Harbor, Maine.—The location of Rockland Harbor is such that besides accommodating its own commerce, it affords a convenient refuge for large numbers of coasting vessels. When the project for a breakwater was adopted, the harbor was open to easterly storms, the anchorage was unsafe, and the seas often broke over the wharves.

The project as originally adopted in 1881 provided for two breakwaters, one starting from Southwest Ledge in the harbor and running in a northerly direction toward Jameson Point, a distance of 2,640 feet; the other starting from Jameson Point and extending southward about 1,900 feet. The estimated cost was $550,000. The top of each breakwater was to be only 5 feet above the level of mean low tide.

November 3, 1886, the project was amended so as to bring the top of the breakwater from Jameson Point to the level of high tide, leaving the other as originally designed. The estimated cost was thus increased to $650,000.

May 2, 1890, the Secretary of War approved a further modification of the project. Instead of building the second breakwater from Southwest Ledge in a northerly direction, on which no work had been done, it was decided to prolong the one from Jameson Point in a southerly direction. By doing so a much larger area of the harbor would secure protection. The estimated cost of the new project was $632,500, this being inclusive of the part already constructed.

Under the act of 1894 a survey was made of the harbor with a view to making it available for vessels of a deeper draft. A report on this survey, submitted in December, 1895, contained a plan for further improvement by removing two dangerous groups of ledges occupying central positions in the harbor, and for dredging along the harbor line to depths of from 4 to 13 feet at mean low tide. The estimated cost of this improvement was $402,000. Congress, by act of June 3, 1896, included this plan in the project for improving Rockland Harbor, making the estimated cost of the combined project $1,034,500. The same act authorized the removal of an old hulk at a cost not to exceed $1,500, and provided the means. This addition brought the total cost of the improvement up to $1,036,000, of which $275,500 had been appropriated. The act of 1896 also authorized contracts to be made for the work necessary to complete the projects. The item in the act is as follows:

Improving harbor at Rockland, Maine: Continuing improvement, including project

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recommended by Chief of Engineers under date of December fourteenth, eighteen hundred and ninety-five, twenty-five thousand five hundred dollars, of which one thousand five hundred dollars may be expended for the removal of an old hulk sunk in the harbor: *Provided*, That contracts may be entered into by the Secretary of War for such materials and work as may be necessary for the completion of said projects for the improvement of said harbor, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate seven hundred and sixty thousand five hundred dollars, exclusive of the amount herein and heretofore appropriated.

Up to the close of the fiscal year ending June 30, 1896, there had been expended on the breakwater the sum of $249,628.10, and 283,143 tons of stone had been placed in position, practically completing the work from the shore end out to a point 2,736 feet from high-water line.

During the fiscal year 1897 the expenditures amounted to $872.38. A contract was made May 4, 1897, for completing the breakwater. The contractor began delivering stone June 3, 1897, and at the close of the fiscal year had deposited 2,260 tons in place.

It has been deemed best to defer the rock excavation and dredging contemplated by the project until after the breakwater is completed, it being thought that the additional protection given by the breakwater will reduce the cost of the rock work.

The tonnage of Rockland Harbor for 1896 is given as 580,295 tons. The chief items were 215,250 tons of wood and cooperage, and 127,500 tons of lime.

July 1, 1896, balance unexpended		$25,871.90
Amount appropriated by sundry civil act approved June 4, 1897		350,000.00
		375,871.90
June 30, 1897, amount expended during fiscal year		872.38
July 1, 1897, balance unexpended		374,999.52
July 1, 1897, outstanding liabilities	$330.00	
July 1, 1897, amount covered by uncompleted contracts	207,550.00	
		207,880.00
July 1, 1897, balance available		167,119.52

Amount (estimated) required for completion of existing project..... 410,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899 410,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix A 11.)

12. Carvers Harbor, Vinalhaven, Me.—The anchorage at this harbor is limited and the harbor shoal, there being less than 8 feet at mean low tide over the most of it, which is not sufficient for the class of vessels freighting at that place.

A survey was made under the provisions of the act of 1894, and a report was submitted in February, 1895, containing two plans of improvement. The first was to dredge the inner harbor to a depth of 10 feet at mean low tide, and to make a larger area available for anchorage by the construction of a breakwater in the outer harbor, at a total estimated cost of $69,500. The second plan, estimated to cost $64,000, was to dredge the inner harbor to a depth of 16 feet at mean low tide. The latter constitutes the present project.

There had been no expenditures up to the close of the fiscal year ending June 30, 1896, and no work had been done.

There were no expenditures during the fiscal year 1897, and no work was done. Proposals for beginning the dredging of the harbor have been invited, the bids to be opened July 21, 1897.

The tonnage for 1896 was given as 63,078 tons, nearly 49,000 tons of which was stone.

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July 1, 1896, balance unexpended	$10,000.00
July 1, 1897, balance unexpended	10,000.00
Amount (estimated) required for completion of existing project	54,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	54,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix A 12.)

13. Georges River, Maine.—This river has a depth of about 3½ fathoms up to within about a mile of Thomaston, but from there the channel is narrow, with a least depth of about 11 feet at mean low tide, with a sharp bend in the channel.

A survey was made under the act of 1894, and the report submitted in January, 1895, contained a project, estimated to cost $30,000, for deepening channel to 16 feet at mean low tide for a width of from 90 to 220 feet and for repairing a stone beacon. By act of June 3, 1896, Congress adopted this project and made the first appropriation.

There had been no expenditures up to the close of the fiscal year ending June 30, 1896, and no work had been done.

There were no expenditures during the fiscal year 1897, and no work was done. A contract has been made for dredging to the extent of the available funds, the work to be done during the present season.

The tonnage for 1896 is put at 45,375 tons, 19,000 tons of which was lime, the other principal items being coal, lumber, ship timbers, and wood.

July 1, 1896, balance unexpended	$10,000.00
July 1, 1897, balance unexpended	10,000.00
July 1, 1897, amount covered by uncompleted contracts	9,000.00
July 1, 1897, balance available	1,000.00
Amount (estimated) required for completion of existing project	20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix A 13.)

14. Kennebec River, Maine.—Before the improvements were commenced the main channel of the river between the foot of Swan Island and Gardiner was obstructed by shoals near Beef Rock, with only 10 feet of water at mean low tide, by dangerous sunken ledges in Lovejoy Narrows, by a shoal below South Gardiner with only 8 feet on it at mean low tide, and by a ledge at Nehumkeg Island. The steamboat channel to the west of Swan Island (at Hatchs Rock) was obstructed by a shoal over which there was only 7½ feet of water, and the channel between Gardiner and Augusta, a distance of 6½ miles, was obstructed by shoals which gave a navigable depth of only 3½ feet of water in low summer tide.

Appropriations were made at various times between 1827 and 1852 for improving the river, and a project was adopted in 1866 for removing rocks and straightening and deepening the upper part of the river. The estimated cost was $50,000.

In 1868 the project was amended so as to give a wider channel, and the estimate was increased to $80,000. In 1871 the project was extended, the additional cost being estimated at $13,000, making the estimate for the entire project $93,000. It was again extended in 1872 to include the removal of ledges in Lovejoy Narrows at an additional estimated cost of $30,603.61. This project was modified in 1873, and as modified was completed in 1877.

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In 1881 a project was adopted for the improvement of the channel west of Swan Island and near the north end of it. The estimated cost of this project, which was completed in 1883, was $20,500.

The river and harbor act of 1886 provided for a new survey of the river from Bath to Augusta. This survey was made in 1887, and a project submitted for a further improvement of the river, giving 12 feet clear depth at low tide up to the Upper Sands Bar, near South Gardiner, 10 feet thence to Hinckley Shoal, and 8 feet thence to Augusta, together with an improvement of the steamboat channel west of Swan Island to 9 feet at mean low tide. The estimated cost of this project was $410,500, which estimate was subsequently increased to $428,500.

In August, 1892, the project was revised and a general project for the improvement adopted, as follows: For a channel depth of 13 feet up as far as Sands Island; 12 feet thence to Hinckley Shoal and 10 feet thence to Augusta; a steamboat channel 9 feet deep west of Swan Island, and the removal of old bridge piers at Hallowell, all the above depths being referred to mean low tide. The estimated cost of this revised project, which was approved August 19, 1892, was $388,500.

The total expenditures for the river up to June 30, 1896, amounted to $420,447.10. The following work had been accomplished: The channel near Beef Rock had been improved to give a clear depth of over 12 feet, and a training wall completed. The dangerous rocks in Lovejoy Narrows had been removed to a depth of 12 feet, and some of them to 15 feet, and the channel straightened. Channels had been dredged to 12 feet at mean low tide through Upper Sands Bar, Gardiner Shoal, Browns Island Shoal, and Hinckley Lower Shoal, and to 10 feet through Hinckley Upper Shoal; thence to Augusta, about 3½ miles, the channel had been deepened to about 7 feet, though some shoaling had since taken place. The ledge at Nehumkeg Island had been removed to 12 feet, the steamboat channel west of Swan Island had been deepened to 11 feet, and the old piers of the bridge at Hallowell had been removed. A jetty about 1,500 feet long had been built at Upper Sands Bar.

The operations during the fiscal year consisted in redredging the channels west of Swan Island, in removing ledge to a depth of 15 feet at mean low tide at Lovejoy Narrows, and in dredging through Britts Shoal for a width of 100 feet to a depth of 10 feet at mean low tide. All the above work was completed. Unless new conditions develop, only the dredging of Gages Shoal, near Augusta, is to be done in order to complete the project. Bids for the latter work were received March 31, 1897, but the proposals containing provisions at variance with the specifications all were rejected. The work has been readvertised, the bids to be opened July 21, 1897.

It has been impracticable to obtain commercial statistics for 1896. In 1895 the tonnage was given as 1,162,972 tons, the chief items being 872,000 tons of ice and 168,429 tons of coal.

July 1, 1896, balance unexpended	$79,902.90
June 30, 1897, amount expended during fiscal year	27,656.31
July 1, 1897, balance unexpended	52,246.59
July 1, 1897, outstanding liabilities	200.00
July 1, 1897, balance available	52,046.59
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	58,500.00

(See Appendix A 14.)

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15. Sasanoa River, Maine.—Originally this stream was much obstructed in the vicinity of Upper Hell Gate. The channel at and near that place was crooked and narrow and obstructed by dangerous ledges, the shoalest of which had not more than 3 feet of water on it at mean low tide.

Between 1870 and 1871 the sum of $45,500 was appropriated, and the navigation was much improved by rock excavation, dredging, and the construction of a small jetty.

A survey was made under the act of 1894, and the report, submitted in December of that year, contained a new project, estimated to cost $19,000, for widening the channel at Upper Hell Gate to a width of 125 feet, with a depth of 12 feet at mean low tide, by ledge excavation; for dredging to the same depth at Carletons ledges, and for constructing a beacon on the jetty at Camp Ground. Congress adopted the project by the act of June 3, 1896, and made an appropriation of $19,000 for its execution.

There had been no expenditures under the present project up to the close of the fiscal year ending June 30, 1896, and no work had been done.

The expenditures during the fiscal year 1897 were $439.07.

The removal of ledge at Hell Gate was commenced during the latter part of May, and was in progress at the close of the year, when about 113 cubic yards of ledge had been removed under a contract covering the removal of about 900 cubic yards.

It has been impracticable to obtain commercial statistics for 1896.

July 1, 1896, balance unexpended		$19,000.00
June 30, 1897, amount expended during fiscal year		439.07
July 1, 1897, balance unexpended		18,560.93
July 1, 1897, outstanding liabilities	$174.10	
July 1, 1897, amount covered by uncompleted contracts	9,190.96	
		9,365.06
July 1, 1897, balance available		9,195.87

(See Appendix A 15.)

16. Portland Harbor, Maine.—The entrance to the main part of the harbor of Portland, or the anchorage, has always been good, but prior to the improvements made by the Government the approach to the inner harbor was obstructed by a shoal known as the middle ground, over which the depth was only from 8 to 10 feet at mean low tide, while between it and Stamford Ledge the greatest available depth was only 16 feet. Besides, the best part of the wharf front of the city was exposed to the swell from the Atlantic, which sometimes made it dangerous for vessels to lie at the docks, and the depth along this front was in some places as little as 4 feet, making a part of it unavailable for commercial purposes.

The first work of improvement undertaken by the Government was the construction of the breakwater. This was begun as early as 1836. It was completed in 1874.

The project for the improvement of the harbor by deepening its waters was first undertaken by authority of act of Congress of 1868. The project at that time was to excavate a channel 300 feet wide through the southern slope of the middle ground to a depth of 20 feet at mean low tide and the removal of the bar off the Grand Trunk wharves to the same depth.

In 1870 the project was amended so as to provide for a channel 400

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feet wide, and in 1871 it was again amended so as to provide for a width of 500 feet.

In 1872 the improvement of Back Cove was added to the project, and in December of that year the project was further amended by providing for the dredging of the inner harbor up to the harbor commissioners' lines to a depth of 16 feet. By 1876 all the contemplated improvements had been executed except some dredging in the inner harbor.

In 1881 Congress made an appropriation for the further improvement of the harbor, and a project was adopted looking to the entire removal of the shoal known as the middle ground, at an estimated cost of $160,000. The project was completed in 1885.

In 1886 the Board of Trade of Portland asked for the further improvement of the harbor to a depth of 29 feet at low tide, and in 1886 this project was adopted, the estimated cost being $135,000. Under approval of the Secretary of War, dated February 20, 1890, this project was extended to include a small quantity of dredging in the upper harbor, estimated to cost $5,000, making the total estimated cost of the project $140,000. In February, 1894, it was again extended to cover the widening of the upper end of the 29-foot channel and the dredging of a 25-foot channel to connect the deep water in the lower part of the harbor with that in the upper part, but without addition to the estimated cost. In November, 1894, all the work proposed for Portland Harbor up to that time was completed.

By the act of 1896 Congress adopted a project for dredging to a depth of 30 feet at mean low tide over the greater part of the area of the harbor. This work was estimated to cost $770,000, and the same act combined with it the project for improving Back Cove, which was partly completed. The total estimated cost of the combined project was made $946,500.

The act of June 3, 1896, appropriated $20,000 for this work and authorized the making of contracts for its completion, but limited such contracts to $810,000 in addition to the amount appropriated. The language of the act is as follows:

> Improving Portland Harbor, Maine, according to the report of the Chief of Engineers dated April seventeenth, eighteen hundred and ninety-six, and continuing improvement of Back Cove, according to existing project, twenty thousand dollars: *Provided*, That contracts may be entered into by the Secretary of War for such materials and work as may be necessary for the completion of such projects, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate eight hundred and ten thousand dollars, exclusive of the amount herein appropriated.

The total amount expended on Portland Harbor, including Back Cove, up to June 30, 1896, was $692,435.25. These expenditures resulted in giving, by means of the breakwater, partial protection to vessels at the lower wharves and an available depth of 29 feet at mean low tide up to said wharves; in Back Cove the channel had been dredged to the full width of 300 feet for about one-half its length and to a width of about 215 feet for the remaining length.

There was no work of improvement done during the year. June 4, 1897, a contract was entered into for doing all the work covered by the present project. At the close of the year the contractors had placed a dredge and two scows on the work, but no dredging had yet been done.

The tonnage for 1896 is given as 1,357,575 tons, the largest single item being 542,055 tons of coal and wood.

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July 1, 1896, balance unexpended		[1] $20,291.80
Amount appropriated by sundry civil act approved June 4, 1897		350,000.00
		370,291.80
June 30, 1897, amount expended during fiscal year		1,731.37
July 1, 1897, balance unexpended		368,560.43
July 1, 1897, outstanding liabilities	$400.00	
July 1, 1897, amount covered by uncompleted contracts	518,499.00	
		518,899.00

Amount (estimated) required for completion of existing project 460,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899 450,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix A 16.)

17. Saco River, Maine.—The first work done on the Saco River was in 1827, when an appropriation was made for the erection of piers, placing beacons or buoys, and removing obstructions. Prior to this the depth of water on the bar was only about 2 feet at mean low tide, while much of the river was deeper. The entrance was also dangerous in rough weather, and the numerous projecting rocks and ledges in the river proper, in connection with the swift currents, made its navigation dangerous.

In 1866 a plan was proposed for the improvement of the mouth of the river, and a project was adopted in 1867. The project was for the construction of a breakwater, the removal of sunken rocks, and the rebuilding of some of the most important piers, against which vessels might drift without damage. This project was completed in 1878 at a cost of $169,275.

Nothing more was done on the Saco until 1883, when a resurvey of the breakwater was made and a new project submitted for raising and repairing it and extending it out to Sharps Ledge.

The river and harbor act of 1884 directed a survey to be made of the river. This was done in 1885 and a project submitted for the improvement of the river proper from its mouth to the head of navigation. In 1886 and 1888 appropriations were made for repairing and raising the breakwater and for improving the river. In 1890 the two projects were combined, so that the one now in process of execution is for improving the Saco River, including the breakwater, and the construction of a jetty opposite the latter.

The total expenditures on both river and breakwater up to June 30, 1896, amounted to $331,081.12, and resulted in removing the dangerous ledges, in constructing piers to prevent vessels from being swept on the rocks, in constructing a substantial breakwater on the north side of the entrance and a jetty on the south side of the entrance to contract the channel way with a view to obtaining a greater depth over the bar; also in deepening the channels in the upper portion of the river by dredging and the construction of contraction works.

No work was done during the year.

An examination at the mouth of the river, made in December 1896, showed that a 6-foot channel had developed and maintained under the combined influence of the breakwater and jetty, and that all that remains to be done to complete the project is to raise the shore end of the breakwater and extend it far enough inshore to prevent sand from being carried over and around it during northeasterly storms.

No further appropriation is asked for the present.

[1] Includes $291.80 from account for Back Cove.

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The tonnage for 1896 is given as 59,756 tons, the largest item being 30,000 tons of brick and 18,000 tons of coal.

July 1, 1896, balance unexpended	$10,693.88
June 30, 1897, amount expended during fiscal year	317.33
July 1, 1897, balance unexpended	10,376.55
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	52,500.00

(See Appendix A 17.)

18. Bellamy River, New Hampshire.—A survey was made of the Bellamy River in 1887, and a project of improvement submitted; estimated cost $28,000, subsequently increased in 1891 to $35,000. Originally the river was too shoal for any navigation except for a short distance from its mouth.

The project is to secure a channel 50 feet wide and 5 feet deep at mean low tide, from the mouth of the river up to Sawyer's mill, at Dover. The rise and fall of tide being about 7 feet, a high-water navigation of 12 feet will be secured. This project was adopted in 1888.

The expenditures up to the close of the fiscal year ending June 30, 1896, amounted to $29,264.01, and resulted in giving a channel from the mouth to within a short distance of its projected limit, 50 feet wide and 5 feet deep at low tide.

Operations during the fiscal year consisted in completing the dredging of the channel and turning basin, the work being finished in September, 1896.

Commercial statistics for 1896 could not be obtained. The tonnage for 1895 was given as 17,541 tons, the chief item being 15,000 tons of brick.

July 1, 1896, balance unexpended	$5,735.99
June 30, 1897, amount expended during fiscal year	5,378.97
July 1, 1897, balance unexpended	357.02

(See Appendix A 18.)

19. Cocheco River, New Hampshire.—Before the improvement was begun, the river from Dover to the Lower Narrows was much obstructed by bowlders, ledges, and shoals, the depth being in some places as little as 6 inches at mean low tide. The tide rises and falls about 7 feet.

A project for improvement was adopted in 1871, which provided for a channel 40 feet wide and 4 feet deep from the Lower Narrows up to Collin's wharf. The estimated cost was $45,000. Subsequently, more accurate and extended surveys having shown the practicability and importance of extending the improvements up to the head of navigation, the project was extended and the estimate increased to $85,000. This project was completed in 1879. The improvements had opened up a large commerce, employing large vessels where formerly only flatboats had been used, in consequence of which the project was still further extended by providing for a "cut-off" through Alleys Point, widening to 60 feet and deepening to 5 feet the existing channels through Trickeys and Clements Point shoals, and blasting and removing other obstructions. The extended project was completed in 1888.

In 1889 a new survey was made under the river and harbor act of 1888, and a new project was submitted for obtaining a depth of 7 feet, increased to 7½ in rock, with a width of 50 feet in rock and 60 to 75 where the material is less expensive to remove. This project was adopted in 1890, and is estimated to cost $175,000.

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The total expenditures up to June 30, 1896, amounted to $217,080.02. These expenditures resulted in giving a channel through the rocky bed of the river 5 feet deep and 40 feet wide in the narrowest parts, where the depth before was only from 6 inches to 2 feet. Under the last project the upper end of the channel at Dover had been deepened to 7 feet at mean low tide for a length of 1,200 feet, with a width varying from 100 to 140 feet. Portions of the channel above and below Clements's wharf, of a total length of 600 feet, had also been dredged to the same depth, and the excavation of the channel through the ledge at Upper Narrows was nearly completed.

The operations consisted in completing the excavation of the channel through the Upper Narrows and the removal of a small shoal at Dover, formed during the freshet of March, 1896.

The tonnage for 1896 is given as 59,756 tons, the principal items being brick and coal.

July 1, 1896, balance unexpended		$22,919.98
June 30, 1897, amount expended during fiscal year		8,137.67
July 1, 1897, balance unexpended		14,782.31
July 1, 1897, outstanding liabilities	$1,924.78	
July 1, 1897, amount covered by uncompleted contracts	9,750.00	
		11,674.78
July 1, 1897, balance available		3,107.53

Amount (estimated) required for completion of existing project	105,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix A 19.)

20. Harbor of refuge at Little Harbor, New Hampshire.—A survey was made of Little Harbor in 1882, and a plan of improvement proposed for the opening of a channel of entrance to a depth of 9 feet at low tide and a width of 100 feet, together with a basin 300 by 700 feet, which was to be protected by a rubblestone breakwater. The estimated cost was $33,000. This project was approved in 1886, and its execution entered upon. In 1887 the project was enlarged to provide for the construction of two breakwaters—one on the north the other on the south side of the entrance to the harbor—and the dredging of an anchorage about 49 acres in extent in the protected area to a depth of 12 feet at mean low tide. The estimated cost of the enlarged project was $235,000, and the act of 1888 made an appropriation for the work on the enlarged plan.

In October, 1894, after the breakwaters had been completed and a part of the dredging accomplished, the project was amended by reducing the area of the anchorage to be dredged to about 40 acres, instead of 49. At the same time the project was revised, and the cost of the entire work placed at $145,000.

Before the improvement the depth in the harbor was only about 6 feet at low tide, and the anchorage was small and exposed.

The expenditures up to June 30, 1896, amounted to $109,664.13. At that date both breakwaters had been completed and the anchorage had been dredged to a width of 415 feet—9 feet deep at mean low tide for 100 feet of its width and 12 feet deep for the remaining width.

Operations during the fiscal year consisted in widening the anchorage by dredging. Work was commenced June 24, 1897, and by the close of the year 4,829 cubic yards of material had been taken out.

There is no commerce, properly considered as such, in Little Harbor.

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The work is intended as a harbor of refuge, and was used during the last six months of 1896 by about 60 craft, large and small.

July 1, 1896, balance unexpended		$10,335.87
June 30, 1897, amount expended during fiscal year		164.27
July 1, 1897, balance unexpended		10,171.60
July 1, 1897, outstanding liabilities	$100.00	
July 1, 1897, amount covered by uncompleted contracts	8,925.00	
		9,025.00
July 1, 1897, balance available		1,146.60
Amount (estimated) required for completion of existing project		25,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix A 20.)

21. Removing sunken vessels or craft obstructing or endangering navigation.—The wreck of the schooner *L. Holway*, just below Turners Point, Milbridge, Me., was removed during the year and placed in a small cove, where it is to be destroyed. The destruction is not yet completed.

(See Appendix A 21.)

EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The preliminary examinations and surveys of the following localities, required by the river and harbor act of June 3, 1896, were made by the local engineer officers and reports thereon submitted:

1. Preliminary examination of Chandlers River, Maine, with a view to its improvement by dredging from its mouth to the wharves at Jonesboro.—Lieut. Col. A. N. Damrell, Corps of Engineers, submitted report of examination April 22, 1897. He states that the improvement desired is the deepening, widening, and straightening of the channel where necessary, so as to permit of the use of a larger class of vessels than is now possible, and that a channel 6 feet deep at mean low water or 17 feet at mean high water, with a width of 93 feet at the upper end, increasing to 250 feet at the lower end (just above Looks Head), and the same width at the bends, would be sufficient for the traffic; and the Chief of Engineers concurs in advising a survey of the river, estimated to cost $600, upon the results of which a more reliable opinion as to the extent of the improvement, justified by the commerce involved, can be formed. The report was transmitted to Congress and printed in House Doc. No. 43, Fifty-fifth Congress, first session. (See also Appendix A 22.)

2. Preliminary examination of Union River, near the city of Ellsworth, in Hancock County, Me.—Lieutenant-Colonel Damrell submitted report of examination January 30, 1897. The act of June 3, 1896, besides directing this preliminary examination at Ellsworth, also provided for a survey of "Union River, for a deeper and broader channel," and, moreover, made an appropriation of $15,000 for "improving Union River, Maine, by dredging." As Congress has made appropriation for improving this stream, it has apparently determined the worthiness of this particular work. The report was transmitted to Congress and printed in House Doc. No. 6, Fifty-fifth Congress, first session. (See also Appendix A 23.)

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3. Preliminary examination of south channel of branch of Penobscot River, Maine, in Frankfort, in Waldo County, with a view of removing an old wreck, and estimate of cost thereof.—Lieutenant-Colonel Damrell submitted report of examination April 22, 1897. The wreck was found to be in Marsh River, near its junction with the Penobscot, and is reported to be that of the schooner *Swan*. It is the opinion of the local officer, concurred in by the Chief of Engineers, that the wreck should be removed, and that a survey, estimated to cost $100, should be made to obtain data for preparation of specifications. The report was transmitted to Congress and printed in House Doc. No. 45, Fifty-fifth Congress, first session. (See also Appendix A 24.)

4. Preliminary examination of Boothbay Harbor, Maine.—Lieutenant-Colonel Damrell submitted report of examination April 22, 1897. The improvement desired is the widening of the 15-foot area in the upper harbor, so as to bring that depth within reach of the wharves; and it is the opinion of the local officer, which is concurred in by the Chief of Engineers, that this harbor is worthy of improvement by the General Government, provided it be shown by a survey, estimated to cost $500, that such improvement can be effected at a reasonable cost. The report was transmitted to Congress and printed in House Doc. No. 46, Fifty-fifth Congress, first session. (See also Appendix A 25.)

5. Preliminary examination of Oyster River, New Hampshire.—Lieutenant-Colonel Damrell submitted report of examination April 22, 1897. It is his opinion, concurred in by the Chief of Engineers, that the locality is worthy of improvement, provided a survey, estimated to cost $200, should show that the improvement could be made at small cost. The report was transmitted to Congress and printed in House Doc. No. 40, Fifty-fifth Congress, first session. (See also Appendix A 26.)

6. Survey of St. Croix River, below Calais, between Maine and New Brunswick.—Maj. R. L. Hoxie, Corps of Engineers, submitted report of survey May 7, 1897. The plan of improvement presented contemplates providing a channel 12 feet deep at mean low tide, and 200 feet wide at the lower end, near Hills Point, contracting gradually, except at bends, to 100 feet at the upper end, near the toll bridge at Calais, the cost of which is estimated to be $200,000, with a small annual expenditure for maintenance. If the resulting benefit to commerce is to be the measure of the division of cost between the two countries, it is estimated by the local officer that the United States should bear nine-tenths of the expense and the Dominion of Canada one-tenth. But if each Government is to pay for the work to be done within the limit of its own territory, then the cost of the improvement should be equally divided between the United States and Canada. Major Hoxie states that the present condition of the channel which needs improvement is due in a great measure to the accumulation of refuse thrown into the stream by sawmills on both sides of the river. In his opinion the Canadian Government will not appropriate money for improvement of this river until preservation of channel is assured by the absolute suppression of the practice of throwing mill waste into it, and the United States should take the same position. Subject to this condition, however, he considers the proposed improvement to be eminently worthy. The report was transmitted to Congress and printed in House Doc. No. 55, Fifty-fifth Congress, first session. (See also Appendix A 27.)

7. Survey of Machias River, Maine, from Machias to Machiasport.—Lieutenant-Colonel Damrell submitted a report of survey April 23, 1897. A project for improvement of this locality was completed in 1877, and

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in 1894 a survey was made, and a new project for improvement was submitted under date of January 9, 1895.

In view of an examination made in November, 1896, which showed that the survey of 1894 and the project and estimate submitted in 1895 were still good, a new survey was deemed an unwarranted expense, and Lieutenant-Colonel Damrell again presents the project proposed in 1895, which is to open a channel 125 feet wide and 7 feet deep at mean low tide (about 20 feet at high tide), except at and above Middle Rock, estimated to cost $50,000. In his opinion the river is worthy of improvement, but it is reported that mill waste is still allowed to go into the river both at Machias and above, which would again fill up in time any channel that might be dredged. The report was transmitted to Congress and printed in House Doc. No. 48, Fifty-fifth Congress, first session. (See also Appendix A 28.)

8. Survey of Bangor Harbor and Penobscot River, including mouth of Kenduskeag River, Maine.—Lieutenant-Colonel Damrell submitted report of survey April 23, 1897. Under former projects for improvement of this locality a good, navigable, safe channel of 22 feet up to Winterport, of 12 feet up to above Stern's mill, and 11 feet up to Bangor, at extreme low tide, has been obtained, and the local officer states that what is now needed is the dredging of a channel 90 feet wide and 2 feet deep at extreme low tide, or 15 feet at ordinary high tide, in Kenduskeag River from its mouth up to Kenduskeag Bridge, and deepening the harbor of Bangor in front of the Boston and Bangor Steamboat Wharf to 11 feet from the harbor line out, estimated to cost:

For Kenduskeag Channel	$10,680.45
For the other work	17,940.45
Total	28,620.90

Lieutenant-Colonel Damrell is of opinion that the river is worthy of the improvement proposed. The report was transmitted to Congress and printed in House Doc. No. 49, Fifty-fifth Congress, first session. (See also Appendix A 29.)

9. Survey of Harraseeket River, Maine.—Lieutenant-Colonel Damrell submitted report of survey April 23, 1897. Under appropriations heretofore made for improvement of this river a channel was obtained with a width of 90 feet and a depth of 14 feet at high tide, a central cut 70 feet wide having a depth of 17 feet at high tide. No survey was considered necessary at this time. Lieutenant-Colonel Damrell states that a channel 70 feet wide and 20 feet deep at high tide can be obtained at an estimated cost of $8,000, but as the prospective commerce upon which the previous improvement was based has not developed, and as there seems to be no immediate prospect of it, it would seem that further improvement might be deferred until there should appear to be a need for it. The report was transmitted to Congress and printed in House Doc. No. 47, Fifty-fifth Congress, first session. (See also Appendix A 30.)

10. Survey of Royal River, Maine.—Lieutenant-Colonel Damrell submitted report of survey April 23, 1897. He states that the improvement desired is the deepening of the present 6-foot channel to 7 feet at mean low water, and to widen it where it is narrow from Yarmouth down about one-third of a mile, which he estimates will cost about $4,400; but in his opinion the commerce, both present and prospective, is so small that the expenditure of even the amount required for the improvement would not be justified by the interests involved. The report was transmitted to Congress and printed in House Doc. No. 44, Fifty-fifth Congress, first session. (See also Appendix A 31.)

11. Survey of Exeter River, New Hampshire, from its mouth to the

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upper bridge in Exeter.—Lieutenant-Colonel Damrell submitted report of survey April 23, 1897. This river has heretofore been under improvement by the United States, the work being completed in 1881, and the project now presented contemplates the restoration of the channel depths and widths up to Oxbow, and thence up to Exeter, to obtain 1 foot more (11 feet at mean high water) than before with the same width, with a turning basin at the upper end, 200 by 110 feet, estimated to cost $12,000. It is the opinion of Lieutenant-Colonel Damrell that the river is worthy of improvement, at least to the extent of restoring the old channel obtained in 1881. The report was transmitted to Congress and printed in House Doc. No. 41, Fifty-fifth Congress, first session. (See also Appendix A 32.)

IMPROVEMENT OF RIVERS AND HARBORS IN EASTERN MASSACHUSETTS.

This district was in the charge of Lieut. Col. S. M. Mansfield, Corps of Engineers, having under his immediate orders Lieut. Meriwether L. Walker, Corps of Engineers, from July 14, 1896, to December 29, 1896, and Lieut. John S. Sewell, Corps of Engineers, since April 6, 1897.

1. Newburyport Harbor, Massachusetts.—Newburyport, Mass., is situated about 2½ miles from the Atlantic Ocean, on the south bank of the Merrimac River. The mouth of the river is obstructed by a sandy bar, over which originally but 7 feet draft at low water could be carried in a narrow shifting channel.

The object of the improvement is to create through the outer bar a channel 1,000 feet wide and at least 17 feet deep at mean low water, so that vessels may cross the bar and find a harbor at any stage of the tide with as great draft as can reach Newburyport by the river at high tide.

The project submitted September 16, 1880, proposed two converging rubblestone jetties, their outer ends 1,000 feet apart and to be extended parallel to the axis of the channel if necessary; and the protection of the beach in their vicinity.

The estimated cost of the converging portions of the jetties and the shore protection was $240,000 (Annual Report, Chief of Engineers, 1881, Part I, p. 507).

This estimate was revised in 1881, and increased to $365,000 (Annual Report, Chief of Engineers, 1881, Part I, p. 502).

The project was modified in 1882 so as to provide for the partial closing of Plum Island Basin with a timber dike about 800 feet long and 5½ feet above mean low water (Annual Report, Chief of Engineers, 1883, Part I, p. 434).

The direction of the south jetty and the character of the shore protection was modified in 1883. The north jetty, from Salisbury Beach, was to be about 2,900 feet long, and the south jetty, from Plum Island, about 1,500 feet long, including shore extension.

Both are 15 feet wide on top, which is a plane 12 feet above mean low water. The two jetties have slopes of 1 on 2 on the sea side and of 1 on 1 on the harbor side.

In 1884 the estimate of cost was increased to $375,000, to include cost of the dike closing Plum Island Basin. (Annual Report, 1884, vol. 1, p. 494.)

In 1884 it was proposed to extend both jetties parallel to the axis of the channel for a distance of 610 feet. No estimate of cost of extension was made. (Annual Report, 1884, Part I, p. 496.)

In 1886 it was proposed to make the parallel jetties 1,000 feet long. No estimate of cost of parallel portions was made. (Annual Report, 1886, Part I, p. 558.)

On March 24, 1897, an estimate of cost of the parallel extensions of

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the jetties was submitted. This estimate increased the total estimate of cost of the improvement $224,547.49.

The total appropriations to date have been $313,500.

The total expenditure to June 30, 1896, was $295,957.29, and at that date the north jetty was completed for a length of 2,705 feet and the south jetty for 1,540 feet.

The Plum Island Dike was 817 feet long, 5½ feet high above mean low water, except near the center, where a weir 150 feet long and 2 feet above mean low water was left temporarily.

The sand catch in rear of the south jetty was in two branches, one 480 feet long and one 572 feet long.

The channel across the bar had been deepened to 13 feet at mean low water, affording greatly increased facilities to navigation.

On October 12, 1896, a contract was entered into for the delivery of 13,000 tons of stone in the south jetty.

Operations were in progress under this contract during the fiscal year, but as only 476 tons of stone has been deposited in the jetty to date the works of improvement remain practically unchanged.

The survey of the bar made in June, 1897, shows by comparison with the survey of 1895 that the extension of the south jetty has made its influence felt upon the bar, resulting in a shoaling of the channel extending to the southward along the shore of Plum Island from 13 feet to 10.5 feet depth at mean low water, and the opening of another channel through the bar of about equal width and depth to the eastward in the location proposed by the project of improvement.

July 1, 1896, balance unexpended		$17,542.71
June 30, 1897, amount expended during fiscal year		999.06
July 1, 1897, balance unexpended		16,543.65
July 1, 1897, outstanding liabilities	$528.54	
July 1, 1897, amount covered by uncompleted contracts	12,899.72	
		13,428.26
July 1, 1897, balance available		3,115.39

Amount (estimated) required for completion of existing project	286,047.49
Amount that can be profitably expended in fiscal year ending June 30, 1899	286,047.49
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix B 1.)

2. Merrimac River, Massachusetts.—The mouth of the Merrimac River is 15 miles northwest from Cape Ann, Massachusetts. Tide water extends up it a distance of 21½ miles, or to the foot of the Upper Falls, 1½ miles above Haverhill, Mass.

Seven incorporated cities and the largest mills in New England are directly interested in this improvement.

Before improvement the channel was narrow and crooked, and much obstructed by ledges, bowlders, and shoals.

At mean low water vessels drawing not to exceed 7 feet could enter the river and proceed to South Amesbury, 9 miles from the mouth. The sea bar at the mouth of the river has been improved under specific appropriations for the improvement of Newburyport Harbor, while many sunken rocks and wrecks of piers and vessels lying inside the bar have been removed by general appropriations for the improvement of the river.

The object of the improvement is to widen, straighten, and deepen the natural channel of the river from the bar to the head of tide water.

The rise or fall of the tide at the mouth is 7.7 feet; at Haverhill Bridge, 4.6 feet.

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The project originally adopted in 1870 proposed to remove obstructions from the Upper and Lower Mitchells Falls, and to remove the Gangway Rock and the Boilers in Newburyport Harbor.

The cost was estimated to be $69,025.

The project was modified in 1874 so as to include the removal of rocks in and near the draw of the bridge at Deer Island, 2 miles above Newburyport, and at Rocks Bridge and at Little Curriers Shoals, East Haverhill, so that the channel should have the following depths at ordinary high-water stages of the river: From the mouth to Deer Island Bridge, 5 miles, 16½ feet; thence to Haverhill Bridge, 12½ miles, 12 feet; thence to the foot of Mitchells Falls, Hazeltine Rapids, 1½ miles, 10 feet; thence through Mitchells Falls to the head of the Upper Falls, 2½ miles, not less than 4½ feet when the mill water at Lawrence is running.

This revised project was estimated to cost $147,000.

The total appropriations to date are $247,366.72.

The expenditure to June 30, 1896, was $242,366.72.

The excess of expenditure over the estimate is due to the removal of rocks and other obstructions that were unknown and removal not contemplated when the estimate was made, and by the expense of necessary surveys and examinations not provided for in the estimate.

On June 30, 1894, the project for the improvement of the river was completed.

The act of August 17, 1894, provided as follows:

The Secretary of War is directed out of the appropriation on hand to make a resurvey of said river, with a view of obtaining a depth up to Haverhill equal to that over the bar at Newburyport.

Work on this survey was commenced in December, 1894, and the final report submitted January 15, 1896, and published as House Doc. No. 168, Fifty-fourth Congress, first session.

The river and harbor act of June 3, 1896, appropriated $5,000 for the removal of certain rocks below Rocks Bridge.

On October 15, 1896, a contract was entered into with the Eastern Dredging Company to dredge 800 cubic yards of bowlders from the channel in the vicinity of Rocks Bridge.

The contract was completed in December, 1896.

On May 5, 1897, an estimate was submitted of cost of obtaining a channel 150 feet wide and 7 feet deep at mean low water from Newburyport to Haverhill, in accordance with the river and harbor act of June 3, 1896.

This estimate was published as House Doc. No. 52, Fifty-fifth Congress, first session, and also forms Appendix B 22 of this report.

The commerce involved in this improvement consists of supplies of coal, lumber, etc., for cities and towns situated on its banks to the head of navigation. No definite statement of the amount and value thereof can be given.

July 1, 1896, balance unexpended	$5,000.00
June 30, 1897, amount expended during fiscal year	3,693.95
July 1, 1897, balance unexpended	1,306.05

(See Appendix B 2.)

3. Powow River, Massachusetts.—Powow River is a tributary of the Merrimac River, into which it enters from the north about 3½ miles above Newburyport.

From its mouth tide water extends 9,600 feet in a narrow, crooked channel, not navigable at low water.

The project proposed for its improvement is to dredge a channel 9,600 feet long, 60 feet wide, and 12 feet deep at mean high water, at an estimated cost of $77,000.

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On March 24, 1897, a revised estimate of cost of the improvement was submitted in accordance with Department letter of August 7, 1896, making the total cost of the improvement $100,000.

The total appropriations to date have been $39,000.

The expenditure to June 30, 1896, was $5,125.83.

At that date operations were in progress under a contract dated October 15, 1894, for the improvement of the river.

This was the first work done under the project and no benefit to commerce had been secured at that date.

During the fiscal year the contract of October 15, 1894, was completed, securing a channel of full projected depth and length and at least 30 feet wide.

On October 15, 1896, a contract was entered into for dredging from the channel. This contract was completed May 21, 1897, and at the date of this report the channel is 12 feet deep at mean high water, 45 feet wide for 3,252 feet of its length, and at least 30 feet wide for its full projected length.

July 1, 1896, balance unexpended	$33,874.17
June 30, 1897, amount expended during fiscal year	33,750.24
July 1, 1897, balance unexpended	123.93
Amount (estimated) required for completion of existing project	61,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	61,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix B 3.)

4. Essex River, Massachusetts.—Essex River empties into Ipswich Bay about 3 miles southeast of the mouth of Ipswich River, Massachusetts. It is navigable at high water to the wharves in the town of Essex, a distance of 6 miles, but no navigable low-water channel exists for 12,000 feet below the town wharves.

The mean rise or fall of the tide is 8.8 feet.

The object of the improvement is to widen and deepen the natural channel of the river.

The project for improvement was submitted May 15, 1891, and proposed a channel 60 feet wide and 4 feet deep at mean low water to the wharves at Essex, estimated to cost $25,000.

The total appropriations to date have been $15,000.

The expenditure to June 30, 1896, was $9,711.39.

At that date the channel was at least 25 feet wide and 4 feet deep at mean low water from the mouth to the drawbridge in Essex.

On June 28, 1897, proposals were received for the work under project for expenditure of $5,000, appropriated by the river and harbor act of June 3, 1896.

No other operations were in progress during the fiscal year, and the condition of the improvement at this date is the same as on June 30, 1896.

July 1, 1896, balance unexpended	$5,288.61
July 1, 1897, balance unexpended	5,288.61
July 1, 1897, outstanding liabilities	19.00
July 1, 1897, balance available	5,269.61
Amount (estimated) required for completion of existing project	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix B 4.)

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5. Harbor of refuge, Sandy Bay, Cape Ann, Massachusetts.—Sandy Bay is situated at the northeastern extremity of Cape Ann, Massachusetts. It is about 2¾ miles by 2 miles in area, and is fully protected on the west and south by high hills, but fronts the northeast, and is open to the full effects of easterly and northeasterly gales.

The proposed improvement contemplates the construction of a national harbor of refuge of the first class. The anchorage covered by the breakwater will contain 1,377 acres.

The estimated cost of the improvement is $5,000,000. The original project of 1884 proposed to build only the substructure of the breakwater of rubblestone. The present project, approved March 17, 1892, proposes to build the entire breakwater of rubblestone, the portion below low water to be built of stone of less than 4 tons weight, the upper portion of stone averaging 6 tons weight.

A plan of the bay showing the proposed breakwater was published in the Annual Report of the Chief of Engineers for 1892, page 564.

The total appropriations to date have been $900,000.

The expenditure to June 30, 1896, was $641,696.62.

At that date, 4,600 running feet of the breakwater was built to at least a grade of 22 feet below low water and 40 feet wide on top; 1,200 feet of that length was completed of full section up to low water, and 600 feet was fully completed.

Operations were in progress during the fiscal year, under two contracts, for the deposit of small stone in the breakwater.

Under a contract dated October 15, 1894, 115,893 tons was deposited, and under a contract dated October 12, 1896, 31,667 tons was deposited, making a total of 923,332 tons of small stone deposited below low water and 13,448 tons of large stone deposited above low water in the breakwater to date.

No serviceable sheltered anchorage has as yet been secured by these operations.

At the date of this report 600 running feet of the breakwater is fully completed; 1,200 feet additional is practically completed to low water, and for a further length of 2,800 feet the mound is at least 40 feet wide on top and up to 22 feet below low water.

The entire commerce of New England is directly interested in this improvement.

July 1, 1896, balance unexpended		$258,303.38
June 30, 1897, amount expended during fiscal year		81,788.63
July 1, 1897, balance unexpended		176,514.75
July 1, 1897, outstanding liabilities	$25,335.59	
July 1, 1897, amount covered by uncompleted contracts	131,113.58	
		156,449.17
July 1, 1897, balance available		20,065.58
Amount (estimated) required for completion of existing project		4,100,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		500,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix B 5.)

6. Harbor at Gloucester, Massachusetts.—Gloucester Harbor, an important center for the fishing fleet of New England, is about 20 miles north of Boston. Its inner harbor was originally obstructed by sunken rocks and shoals, and the approaches to the wharves were shallow, varying from 1 to 12 feet. The outer harbor was open to all southerly gales.

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The first project formed for improvement was submitted January 20, 1871, and was based on the survey provided for by the act of July 11, 1870. (Report of Chief of Engineers, 1871, p. 869.) This project proposed the removal of certain bowlders from the inner harbor at a cost, as estimated, of $10,606.20, and the construction of a breakwater from Eastern Point over Dog Bar to Round Rock Shoal, at an estimated cost of $494,148.65.

On November 10, 1884, Maj. C. W. Raymond, Corps of Engineers, by order of the special Board of Engineers that was considering the subject of the Sandy Bay breakwater, submitted a project for two breakwaters at the entrance of Gloucester Harbor, one to cost $752,000, on essentially the same site as that proposed in 1871, and a supplementary one through Normans Woe Rock to cost $607,000.

This project and estimate are published in the Chief of Engineers' Report for 1885, page 534.

On January 20, 1885, it was recommended, in accordance with act of July 5, 1884, that a survey of the inner harbor and of the reef off Muscle Point be made, and that Babsons Ledge be removed to 21 feet at mean low water. (Report of Chief of Engineers, 1885, p. 541.) In the annual report for this harbor for 1887 a general project for its improvement was submitted, based on the survey provided for by the act approved August 5, 1886. (Chief of Engineers' Report, 1887, p. 500.) This project proposed to remove from the inner harbor 101½ cubic yards of rock known to exist, and to dredge 216,000 cubic yards, scow measurement, at an estimated cost of $65,000, and to construct the breakwater recommended in the project of 1884 that extends from Eastern Point to Round Rock Shoal, at an estimated cost of $752,000.

The total appropriations to date are $154,000.

The expenditures to June 30, 1896, were $107,473.93.

The condition of the improvement June 30, 1896, was as follows:

Clam Rock had been reduced from 1 foot to 9⅓ feet, at mean low water; Pinnacle Rock from 8½ to 16½ feet, mean low water; rock off Pew's wharf from 2 to 5 feet, mean low water; rocks off J. Friend's wharf from 13 to 17 feet, mean low water. All of the above rocks were reduced to the level of the surrounding bottom. Babsons Ledge had been reduced from 11 to 14 feet, mean low water. All the proposed dredging had been done and operations were in progress under a contract with the Rockport Granite Company to deposit 57,000 tons of rubblestone at 87 cents per ton of 2,000 pounds in the substructure of the breakwater from Eastern Point to Round Rock Shoal.

Operations under this contract were commenced in November, 1894, and on June 30, 1896, 52,598 tons had been deposited in the breakwater at Eastern Point.

The movement of vessels in the inner harbor had been greatly facilitated, but no benefit had been derived from work on the breakwater, as no sheltered anchorage had been obtained.

During the fiscal year operations were continued under the contract and 4,202 tons of rubblestone was deposited in the breakwater, a total of 56,800 tons deposited under the contract, thus completing it satisfactorily on July 30, 1896.

On October 12, 1896, under the act of June 3, 1896, a contract was entered into with the Rockport, Pigeon Hill and Cape Ann granite companies to deposit 34,000 tons of rubblestone in the breakwater at 83 cents per ton of 2,000 pounds.

Operations were commenced November 21, 1896, and at the date of this report 17,668 tons has been deposited under the contract, and the

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substructure of the breakwater up to low water has been completed for a total length of 1,100 feet.

The river and harbor act of June 3, 1896, allotted $2,000 of the appropriation of $34,000 for this harbor, to be expended in removing a pinnacle rock in the outer harbor, a rock called Elishas Rock in the inner harbor, and a rock off the ferry landing at Rock Neck in the inner harbor.

A survey of these rocks was made in November, 1896, and on May 5, 1897, a project for the removal of the pinnacle rock to 16 feet at mean low water and four projections of ledge off the ferry landing to the level of the surrounding bottom was submitted.

This project was approved by the Secretary of War May 11, 1897. On June 28, 1897, bids were received and opened for the removal of the ledges, and contract for the work was entered into July 6.

No operations were in progress under this project during the fiscal year.

The commerce chiefly interested in this improvement is the large New England fishing industry. The work in its present stage has greatly benefited this industry, and its completion will furnish much-needed sheltered anchorage in this important harbor.

In addition to this fishing interest a line of passenger and freight steamers is operated continuously throughout the year; and other commerce exists in the form of imports of salt, coal, lumber, etc.

The estimated value of this commerce is $5,000,000 annually.

July 1, 1896, balance unexpended		$46,526.07
June 30, 1897, amount expended during fiscal year		26,911.75
July 1, 1897, balance unexpended		19,614.32
July 1, 1897, outstanding liabilities	$1,991.32	
July 1, 1897, amount covered by uncompleted contracts	13,555.56	
		15,546.88
July 1, 1897, balance available		4,067.44

Amount (estimated) required for completion of existing project	678,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	200,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix B 6.)

7. Harbor at Manchester, Mass.—Manchester Harbor is situated about 5½ miles northeast from the entrance of Salem Harbor, Massachusetts.

The channel was 100 feet wide and 6½ feet deep at mean low water up to Proctors Point; it then shoaled rapidly to a depth of 1½ feet at the "Narrows," 1,400 feet from Proctors Point, and for a further distance of 2,500 feet to the town wharves no low-water channel existed.

The original project for the improvement of this harbor was submitted November 28, 1887. It was based on a survey provided for in the river and harbor act of August 5, 1886. It proposed to dredge a channel 60 feet wide, 4,000 feet long, and 4 feet deep at mean low water from Proctors Point to the town wharves, at an estimated cost of $14,300.

A chart of the harbor was published in the Annual Report of the Chief of Engineers for 1888, part 1, page 466.

The expenditure to June 30, 1896, was $13,653.04, and the improvement was essentially completed. The channel was 60 feet wide, 4 feet deep, and 4,000 feet long; opposite the town wharf it was 80 feet wide.

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The river and harbor act of June 3, 1896, provides that "the Secretary of War is directed, out of the appropriation on hand, to cause a survey and estimate of cost of improvement to be made with a view of straightening the channel between the mouth of Manchester Harbor and Proctors Point, removing obstructions at the mouth of the channel and at the point of rocks, dredging the channel for its entire length between its mouth and the town wharf to a width of from 200 feet, narrowing to 150 feet, and a depth of 8 feet, and providing turning basins and anchorage for boats by the dredging of the flats for that purpose."

This survey was made in August, 1896, and on April 7, 1897, a project was submitted in accordance with the act. The estimated cost of the project is $139,966.09. The report was printed in House Doc. No. 29, Fifty-fifth Congress, first session; it is also submitted as Appendix B 23 to this report. An alternate estimate for a less extensive improvement, estimated to cost $25,000, was submitted July 30, 1897 (see Appendix B 24 of this report).

No other operations were in progress during the fiscal year.

The commerce involved in this improvement consists of supplies of coal, lumber, etc., for local consumption. The improvement in its present condition has greatly facilitated the approach of vessels to the town wharves.

The value of the commerce involved is approximately $30,000 annually.

July 1, 1896, balance unexpended	$646.96
June 30, 1897, amount expended during fiscal year	593.92
July 1, 1897, balance unexpended	53.04

(See Appendix B 7.)

8. Harbor at Lynn, Mass.—Lynn Harbor is situated 9 miles northeast from Boston. It is approximately 1 by 2 miles in extent, of which the greater part is dry at low tide.

It is protected on the north and west by the mainland, on the east by Nahant Beach, and its entrance, 2 miles wide, into Massachusetts Bay is on the south side.

Before improvement three narrow and crooked channels of approach to the wharves existed, in each of which there was about 6 feet depth at mean low water. The mean rise or fall of the tide is 9.3 feet.

The western channel leads to the Point of Pines and the mouth of the Saugus River. The main ship channel is entered between White and Lobster rocks and connects about 3,600 feet northward with the Black Rock Channel, which is the most eastern, near Nahant Beach.

The original project for the improvement was adopted April 10, 1894 (Annual Report, Chief of Engineers, part 1, p. 524). It proposed to excavate a channel 200 feet wide and 10 feet deep at mean low water from a point near and east of White Rocks to deep water, opposite Little Nahant, a distance of 3,610 feet. This is called the outer improved channel.

The inner improved channel, which was projected 6,450 feet long, 200 feet wide, and 10 feet deep at mean low water, extends from deep water, opposite Sand Point, to the harbor commissioner's line and follows very closely in direction the extension of the main ship and Black Rock channels. In addition to the above dredging, the original project proposed a training wall about 6,000 feet long, to start from the shore line at Little Nahant and to cross Black Rock Channel, its outer portion to

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be parallel to the outer improved channel, its purpose being to aid in keeping the outer channel open if experience should show it to be necessary.

It was also suggested that the inner improved channel will need to be dredged occasionally to maintain its width and depth.

The cost of this project was estimated to be $145,000.

A plan of the harbor, showing the projected improvement, was published in the Annual Report of the Chief of Engineers for 1884, part 1, page 532.

The estimate was revised in 1885, and then made $157,000. (Annual Report, Chief of Engineers, 1885, part 1, p. 517.)

On September 24, 1888, this project was modified. It was then proposed to extend the main ship channel 400 feet within the harbor line, and to excavate at its inner end a basin 500 by 300 feet in area, 10 feet deep at mean low water. This extension was authorized by the river and harbor act of August 11, 1888.

This modification was estimated to cost $25,000, which would make the total cost of improvement $182,000.

The total appropriations for this work to date have been $128,500; of this amount $5,000 was expended on the western or Saugus River Channel, as provided for in the act of July 13, 1892.

The total expenditures to June 30, 1896, were $103,500, on the project, and $5,000 on the western or Saugus River Channel; and at that date the outer channel and basin were finished; the inner channel was completed for 4,100 feet at its southern end, and the remainder is 150 feet wide; the western or Saugus River Channel is 4,000 feet long, 150 feet wide, 8 feet deep at mean low water.

The river and harbor act of June 3, 1896, ordered a survey of this harbor "with a view to securing a channel 300 feet wide and 15 feet deep at low water."

The survey was made in October, 1896, and on March 27, 1897, a project was submitted in accordance with the act. The estimated cost of this project is $441,813.07. The report of this survey is published in House Doc. No. 28, Fifty-fifth Congress, first session; also as Appendix B 26 of this report.

On May 8, 1897, a contract was made for dredging 40,000 cubic yards, more or less, to complete inner main ship channel at 21⅞ cents per cubic yard. No operations were in progress under this contract during the fiscal year, and at the date of this report the condition of the improvement is the same as on June 30, 1896.

The commerce involved in the improvement consists of coal, lumber, and other domestic and manufacturing supplies, and the improvement has enabled them to be brought in large vessels, thereby reducing freights and costs.

July 1, 1896, balance unexpended		$20,000.00
June 30, 1897, amount expended during fiscal year		150.05
July 1, 1897, balance unexpended		19,849.95
July 1, 1897, outstanding liabilities	$25.20	
July 1, 1897, amount covered by uncompleted contracts	8,750.00	
		8,775.20
July 1, 1897, balance available		11,074.75

(See Appendix B 8.)

9. Mystic and Malden rivers, Massachusetts.—Mystic River empties

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into the inner harbor of Boston, Mass., and extends from the navy-yard to the town of Medford, a distance of about 4½ miles. Malden River is about 2 miles long from the town of Malden to its junction with Mystic River, about 3 miles above the navy-yard.

Originally Mystic River had no navigable low-water channel. A project for its improvement was submitted May 9, 1891. It proposed to widen and deepen the natural channel of the river so that it should be 100 feet wide and 6 feet deep at mean low water to the first turn above Denning's wharf, and thence to the head of navigation 4 feet deep, with the width gradually reduced to 50 feet at Craddock's bridge. The cost of this improvement was estimated to be $25,000.

Originally in Malden River there was a narrow and exceedingly crooked channel with a navigable depth of barely 7 feet at mean high water. The rise of the tide is 9.8 feet. The original project for its improvement was proposed December 1, 1880. It contemplated the excavation of a channel 100 feet wide and 12 feet deep at mean high water up to the second drawbridge, with two cut-offs, one east of the island, near the junction of the Malden and Mystic rivers, and the other through the marsh land about half a mile above, at a cost of $35,000.

This project was modified in 1882. It was then proposed to make the natural channel 100 feet wide and 12 feet deep at mean high water to the first bridge, and thence 75 feet wide to the second bridge, at an estimated cost of $40,000.

This estimate was increased to $47,000 in 1884 (Annual Report, 1884, p. 551).

Ten thousand dollars was appropriated for this work by the act of 1882 and expended (1883–84) in making the channel from the mouth to the drawbridge in Malden, a distance of 1¼ miles, at least 50 feet wide (70 feet at turns) and 12 feet deep at mean high water.

On November 1, 1890, a project was submitted for the improvement of this river in conjunction with Mystic River. This project proposed the completion of the project of 1882, at an estimated cost of $37,000.

The total appropriations to date, under present approved projects, have been $30,000.

The expenditures to June 30, 1896, under the present projects were $20,000, and at that date the improved channel in Mystic River was 6 feet deep at mean low water and 100 feet wide to the first turn above Denning's wharf, and for a distance of 1,500 feet above this turn 4 feet deep and at least 50 feet wide; and the channel in Malden River was at least 75 feet wide and 12 feet deep at mean high water to the first bridge. Nothing had been done above this bridge. The navigation of both rivers had been greatly facilitated by the improvement.

On October 19, 1896, a contract was entered into for dredging 26,000 cubic yards, more or less, of material from these rivers, at 34½ cents per cubic yard.

Operations under this contract were commenced June 17, 1897, but as only 1,864 cubic yards has been removed at the date of this report, the condition of the improvement is practically the same as on June 30, 1896.

To complete the improvement of Mystic River would require an appropriation of $10,000, and of Malden River $22,000, a total of $32,000, all of which could be expended to advantage during the fiscal year ending June 30, 1899.

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July 1, 1896, balance unexpended		$10,000.00
June 30, 1897, amount unexpended during the fiscal year		117.08
July 1, 1897, balance unexpended		9,882.92
July 1, 1897, outstanding liabilities	$643.08	
July 1, 1897, amount covered by uncompleted contracts	8,326.92	
		8,970.00
July 1, 1897, balance available		912.92
Amount (estimated) required for completion of existing project		32,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		32,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix B 9.)

10. Harbor at Boston, Mass.—Boston Harbor consists essentially of an inner and outer harbor united by a deep waterway, and each accessible from the sea by a distinct channel, widening into a deep and spacious roadstead.

(1) *Inner harbor.*—This harbor lies to the north and westward of Long Island, and has deep water and good anchorage in the President Roads, seaward of Lower Middle Bar, and also near the city westward of Upper Middle Bar.

Four rivers discharge their waters into the basin—the Charles, Mystic, and Chelsea rivers from the north, and the Neponset from the south. The direct entrance from the sea is by Broad Sound.

(2) *Outer harbor.*—This harbor lies to the southward of Long Island, and has a fine anchorage in Nantasket Roads as well as in Hingham Bay, a well-sheltered harbor southeast of Paddocks Island. It connects with the inner harbor by the main ship channel, through the Narrows, and by secondary channels east and west of Long Island. It is reached from the sea by Nantasket Roads, which lie south of Georges and Great Brewster islands, and is marked at the sea entrance by Boston Light.

Weymouth and Weir rivers empty into the outer harbor.

Both the inner and outer harbors are subdivided into several minor harbors, and contain many islands, which shelter the anchorages from winds and storm waves.

The range of the tide at the navy-yard is 9.8 feet, and at the entrance to the outer harbor 9.4 feet. A sketch of the harbor was printed in the Annual Report of the Chief of Engineers for the year 1888, page 454.

The object of the improvement is, first, to preserve the harbor by protecting the islands and headlands; and, second, to improve it by widening, deepening, and straightening the channels.

The works of preservation consist of sea walls, aprons, jetties, etc., which protect the shores of the islands and headlands, prevent additional wash into the channels, control the tidal scour, and preserve the full height of anchorage shelter for vessels in the roadsteads.

The works of improvement have been by dredging and blasting.

The total appropriations from 1825 to date have been $3,274,276.10.

The total expenditure to June 30, 1896 (not including outstanding liabilities), was $2,629,821.85.

Works of preservation.—The location and details of these works are given in the Annual Report of the Chief of Engineers for 1895, pages 621 and 622.

With the exception of the sea walls at Deer Island, they were all in fair order, and no work has been done on them during the fiscal year.

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During the year repairs have been made to about 150 running feet of wall, and about 400 running feet of backing and paving on the North Head and Middle Head walls at Deer Island, and about 100 feet more will require repair before the walls can be considered to be in good condition.

Works of improvement.—The works of improvement have been by dredging and blasting, by which means many dangerous rocks and shoals have been removed, and the main ship channel enlarged from 100 feet wide and 18 feet deep at mean low water, so that on June 30, 1896, it was at least 625 feet wide and 23 feet deep at mean low water throughout, and the lower main ship channel to President Roads was 27 feet deep at mean low water, 1,000 feet wide from the entrance (near the outer light) to Bug Light, and in the Narrows 800 feet wide to the passage between Georges and Gallops islands, where it was at least 550 feet wide; but the free use of this 27-foot channel was restricted by reason of ledges uncovered by the dredging.

The following tributary channels have also been improved, and their condition on June 30, 1896, was as follows:

a. Charles River.—The natural channel of this river has been widened, straightened, and deepened, so that from its mouth to Western Avenue Bridge, a distance of 4¾ miles, the channel has a width of 200 feet and a depth of 7 feet at mean low water. Thence to Arsenal Street Bridge, 2½ miles, the channel has a least width of 80 feet and a least depth of 6 feet.

By the act of September 19, 1890, $20,000 was appropriated for the improvement of Charles River, provided "that the draws in the Arsenal Street and Market Street bridges shall be made to conform to the projected channel without cost to the United States." This sum still remains unexpended because the Market Street Bridge has not been remodeled.

b. Fort Point Channel.—This important branch of the main ship channel had a least depth of 12 feet at its entrance, and the channel was narrow and crooked.

The project for its improvement was submitted January 27, 1885. It proposed the excavation of a channel 175 feet wide and 23 feet deep at mean low water from the entrance to near Federal Street Bridge, a distance of 4,100 feet, and was estimated to cost $100,000, the railroad bridge to be reconstructed at the expense of the owners. It has been widened to 175 feet and deepened to 23 feet at mean low water from its mouth to Congress Street Bridge, a distance of 1,900 feet.

The project can not be completed until the railroad bridge shall have been reconstructed.

c. Nantasket Beach Channel.—This channel was originally about 50 feet wide and 8 feet deep at mean low water. It is now 150 feet wide and 12 feet deep at mean low water.

d. Channel between Nixs Mate and Long Island.—This channel had originally 4½ feet depth at mean low water. A cut has been made through the bar 300 feet wide, 15 feet deep at mean low water.

e. Broad Sound.—An obstruction called Barrel Rock was removed in 1869.

f. Jeffreys Point Channel.—This channel is an extension of the main ship channel from near Grand Junction Wharf (East Boston) toward Jeffreys Point. It is now 400 feet wide from Grand Junction Wharf to just east of Simpson's patent dry docks, and 18 feet deep at mean low water, thence gradually narrowing to 250 feet, and decreasing in depth

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of water to 15 feet at mean low water at a junction with the same depth off Jeffreys Point.

On June 30, 1896, operations were in progress under a contract to remove 8,772 cubic yards of ledge from the main ship channel, and during the fiscal year 5,300 cubic yards was removed, a total of 6,421 cubic yards removed under the contract.

At the date of this report at least 350 feet in width of the 27-foot channel has been cleared of ledges by these operations.

No other operations on the main ship channel were in progress during the fiscal year.

The act of June 3, 1896, provides as follows:

Improving harbor at Boston, Massachusetts: Continuing improvement, seventy thousand dollars: *Provided*, That this sum may, in the discretion of the Secretary of War, be used in the preservation and improvement of said harbor, including the project for improving the main ship channel, and that seven thousand dollars of this sum may, in the discretion of the Secretary of War, be used in improving Chelsea Creek, and so much thereof as the Secretary of War in his discretion shall direct to be expended for the protection of Great Head, Winthrop, to prevent the further washing away by the action of the sea: *Provided*, That contracts may be entered into by the Secretary of War for such materials and work as may be necessary to carry out the revised project of August eleventh, eighteen hundred and ninety-two, such contracts to provide that said ship channel shall be widened to a minimum width of one thousand feet and a minimum depth of twenty-seven feet, to be paid for as appropriations may from time to time be made by law, in the aggregate not to exceed one million one hundred and forty-five thousand dollars, exclusive of amount herein and heretofore appropriated.

On February 11, 1897, a contract was entered into with Messrs. Breymann Bros., of Toledo, Ohio, to dredge 2,910,718 cubic yards, more or less, from the main ship channel in completion of the project of August 11, 1892. No work has as yet been done under this contract.

On October 19, 1896, a contract was entered into with Mr. Augustus B. Martin to dredge 21,000 cubic yards, more or less, of material from Chelsea Creek. Operations under this contract were commenced in November, 1896, and completed in March, 1897. This tributary empties into the upper part of Boston inner harbor, and lies between East Boston and the city of Chelsea. It had originally but 14 feet at mean high water in a narrow channel, very difficult of navigation. The project of improvement proposed to dredge a channel 150 feet wide and 18 feet deep at mean high water to the head of navigation. At the date of this report the channel is 14 feet deep at mean high water, at least 35 feet wide, and of greatly increased width at turns.

No operations were in progress on the other tributary channels during the fiscal year.

July 1, 1896, balance unexpended		$244,454.25
Amount appropriated by sundry civil act approved June 4, 1897		400,000.00
		644,454,25
June 30, 1897, amount expended during fiscal year		100,243.89
July 1, 1897, balance unexpended		544,210.36
July 1, 1897, outstanding liabilities	$11,424.07	
July 1, 1897, amount covered by uncompleted contracts	438,744.48	
		450,168.55
July 1, 1897, balance available		94,041.81

Amount (estimated) required for completion of existing project..... 745,000.00
Amount that can be profitably expended in fiscal year ending June 30,1899 400,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix B 10.)

11. Town River, Massachusetts.—Town River, is a small tidal river,

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debouching into Weymouth Fore River, and lies within the limits of the city of Quincy. It is about 1½ miles long from its mouth at Quincy Point to the upper wharves of the city.

The upper half of the river (three-fourths of a mile) has a very narrow and crooked channel, carrying about 1½ feet of water at low tide.

The project for the improvement of this river was submitted December 31, 1890; it proposed to dredge a channel 4,500 feet long, 100 feet wide, and 4 feet deep at mean low water to the head of navigation, at an estimated cost of $20,000.

On March 24, 1897, this estimate was revised and made $25,000, to allow for increased cost of dredging over estimated cost in 1890.

The total appropriations to date have been $10,000.

On June 30, 1896, no work had been done under the project, and the original condition of the river remained unaltered.

On October 15, 1896, a contract was entered into to dredge 33,000 cubic yards of material from the river. Operations under this contract were commenced late in the fiscal year, but the condition of the improvement at the date of this report is practically the same as on June 30, 1896.

The commerce involved in the improvement of this river consists of coal, lumber, etc., for the city of Quincy, and the output of the Quincy granite quarries shipped by water. The value of this commerce annually will approximate $200,000.

July 1, 1896, balance unexpended		$10,000.00
June 30, 1897, amount expended during fiscal year		105.72
July 1, 1897, balance unexpended		9,894.28
July 1, 1897, outstanding liabilities	$1,345.68	
July 1, 1897, amount covered by uncompleted contracts	7,564.32	
		8,910.00
July 1, 1897, balance available		984.28

Amount (estimated) required for completion of existing project	15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix B 11.)

12. Weymouth River, Massachusetts.—Weymouth Fore River, tributary to Hingham Bay, Boston Harbor, Massachusetts, is one of the most important water courses on the south coast of Massachusetts Bay. It is navigable at low water for vessels not exceeding 18 feet draft for 4 miles from its mouth, and for a further distance of 3 miles, to the head of navigation, at least 3 feet depth was found at mean low water before its improvement.

Weymouth Back River lies east of the Fore River, forming a portion of the boundary between the town of Weymouth and Hingham. Its course is northerly, and it enters into Hingham Bay at the mouth of Weymouth Fore River.

The original project of improvement of Weymouth Fore River was submitted December 2, 1889; it was based on the survey provided for in the act of August 11, 1888, and proposed to improve the natural channel of the river by dredging, so that 6 feet depth at mean low water could be carried to the head of navigation, in a channel 100 feet wide to near the wharves at Weymouth Landing; thence to Braintree Bridge 80 feet wide, and above the bridge 50 feet wide, with increased width at each turn to facilitate the movement of vessels. The total length of channel to be improved was 7,000 feet, approximately, and the cost was estimated to be $40,000.

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The project for the improvement of Weymouth Back River was submitted February 7, 1891. It proposed to dredge a channel through the outer bar 200 feet wide and 12 feet deep at mean low water, and to widen and deepen the natural channel of the river to the same dimensions to the wharf of the fertilizer company, at an estimated cost of $22,000.

The total appropriations for this work to date are $40,000, of which $12,500 must be expended in the Back River.

The expenditure to June 30, 1896, was $22,309.58.

At that date the channel in Weymouth Fore River was 6 feet deep and 60 feet wide to within 700 feet of Braintree Bridge, 40 feet wide thence to Braintree Bridge, and 25 feet wide above the bridge, and the passage of vessels in the river had been greatly facilitated.

Nothing had been done in Weymouth Back River.

On October 19, 1896, a contract was executed for dredging 9,000 cubic yards, more or less, of material from Weymouth Fore River. This contract was completed during the fiscal year, and at the date of this report the project is completed above Braintree Bridge, and the channel is of full depth and at least 60 feet wide below the bridge, with the exception of four small ledges uncovered by the dredging.

On October 16, 1896, a contract was executed for dredging 48,000 cubic yards of material from Weymouth Back River. This contract was completed during the fiscal year, and at the date of this report the channel is at least 12 feet deep at mean low water, 200 feet wide through the bar, and 125 feet wide thence to the Bradley Fertilizer Company's wharf.

This work has rendered possible the passage of much larger vessels as far as it extends.

The character of commerce benefited by the improvement of this river is the supply of coal, lumber, and general merchandise to the populous district surrounding it. The annual value of this commerce approximates $750,000.

July 1, 1896, balance unexpended	$17,690.42
June 30, 1897, amount expended during fiscal year	16,144.03
July 1, 1897, balance unexpended	1,546.39
Amount (estimated) required for completion of existing project	22,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	22,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix B 12.)

13. Harbor at Scituate, Mass.—Scituate Harbor is on the west shore of Massachusetts Bay, 14 miles from either Boston or Plymouth lighthouses and just southwest of the direct sailing course of all ocean going vessels entering Boston Harbor.

Before improvement the harbor had a low-water area of 57 acres, approximately, more than 6 acres of which has a depth of at least 3 feet at mean low water. It was entirely open to the action of east winds and the entrance was obstructed by many sunken bowlders. The depth on the bar was about 2½ feet at mean low water. The mean rise or fall of the tide is 9.8 feet.

The object of the improvement is to create a harbor of refuge for vessels bound to Boston which are too far south of their course to clear the dangerous ledges near Minots Light-House.

The project of improvement, adopted in 1881, is to build two rubble-stone breakwaters converging from opposite shores and to dredge an

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anchorage basin with channels connecting with the sea and the town wharves.

The north breakwater, from Cedar Point, is to be 800 feet long, and the south breakwater, from the point of the first cliff, is to be 730 feet long. Both breakwaters are to be 20 feet wide on top and 4 feet above mean high water, except at their outer ends, which are to be built 6 feet higher, to serve as sites for entrance beacons. The anchorage basin is to be 30 acres in area, approximately. The entrance channel is to be 2,700 feet long and 300 feet average width. The depths proposed were 15 feet in the entrance channel, 12 to 15 feet between the breakwaters, 12 feet immediately in rear of the south breakwater, and 10 feet for the anchorage basin; the channel leading to the town wharves is to be 3 feet deep, all at mean low water.

The estimated cost of the breakwaters was $100,000 and of the dredging $190,000, a total of $290,000.

The plan of the harbor, showing the proposed improvement, was published in the Annual Report of the Chief of Engineers for 1881, part 1, page 522.

The total amount appropriated for this work to date is $89,680, of which $1,180 was expended before the present project was adopted.

The expenditure to June 30, 1896, was $82,500.

At that date the condition of the improvement was as follows:

A portion of the beach between Cedar Point and the mainland was protected by a brush and stone bulkhead 450 feet long, in front of which was a stone apron 10 feet wide, 385 feet long; all known bowlders obstructing the entrance of the harbor were removed; the anchorage basin was 400 by 350 feet in area, 7 feet deep at mean low water; the entrance channel was 1,600 feet long, 100 feet wide, and 5 feet deep at mean low water; the channel connecting the basin with the town wharves was 3 feet deep at mean low water and 100 feet wide, except at the upper end, where for a distance of 75 feet it averaged only 50 feet wide; the north breakwater was 720 feet long, the south breakwater 450 feet long.

The harbor afforded a shelter for a limited number of small vessels.

On October 15, 1896, a contract was executed for dredging 14,000 cubic yards, more or less, from the entrance channel, the object being to deepen it to 7 feet at mean low water for a width of 75 feet throughout its length. Operations were commenced under this contract in June, 1897, and at the date of this report 6,114 cubic yards has been removed under the contract.

The work completed is so small a portion of the proposed work under the contract as not to materially affect the condition of the improvement, which at the date of this report is practically the same as on June 30, 1896.

July 1, 1896, balance unexpended		$6,000.00
June 30, 1897, amount expended during fiscal year		116.53
July 1, 1897, balance unexpended		5,883.47
July 1, 1897, outstanding liabilities	$2,353.89	
July 1, 1897, amount covered by uncompleted contracts	3,036.11	
		5,390.00
July 1, 1897, balance available		493.47
Amount (estimated) required for completion of existing project		201,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		30,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix B 13.)

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14. Harbor at Plymouth, Mass.—Plymouth Harbor is situated 30 miles south of Boston. Its outer anchorage, the "Cow Yard," is common to Plymouth, Kingston, and Duxbury, and is the only refuge for seagoing vessels from northeasterly gales when caught between Boston and Provincetown, a distance of about 75 miles, following the coast line. The entrance to this outer anchorage is direct, unobstructed, of ample width, and sufficiently deep for the wants of commerce. The anchorage is capacious, and has good "holding ground," but the extensive tidal basins inside of it give strong variable currents across it.

The inner or harbor proper is formed by Long Beach, a narrow low sand spit 3 miles long, which extends generally parallel to the mainland and about 1 mile from it.

The harbor contains about 2,000 acres, almost all of which is dry at low tide. A few narrow crooked channels traverse these flats. They join about the center of the harbor, opposite the town wharves, and form the main ship channel (150 feet wide, approximately, and 10 feet deep at mean low water), which runs directly behind the northern half of Long Beach to the outer anchorage.

The maintenance of this inner harbor and channel depends on the preservation of Long Beach.

A chart of the harbor was published in the Annual Report of the Chief of Engineers for the year 1888, part 1, page 460.

Before improvement about 6 inches depth of water could be carried to the town wharves at low tide.

Previous to 1875 the project was a general one, and had for its object the preservation of Long Beach. From the nature of the work it can at no time be considered completed, and small annual appropriations are necessary to repair any damages by storms. The various devices employed for this purpose are described in the Annual Report of the Chief of Engineers for 1877.

The project for the improvement of the harbor was first adopted in 1875. It provided for dredging a channel from the town wharves to the main ship channel 2,286 feet long, 100 feet wide, and 6 feet deep at mean low water. This project was modified in 1877 so as to include the dredging of a basin 866 feet long, 150 feet wide, and 8 feet deep directly in front of the town wharves.

In 1884 and 1885 it was proposed to deepen the channel and basin to 9 feet at mean low water and to make the channel 150 feet wide.

The modified project of 1884 required the excavation of 81,000 cubic yards (scow measurement), and was originally estimated to cost $27,000. This estimate was revised in 1885, in accordance with the low prices then current for dredging, and the cost was then estimated to be $22,500.

From 1824 to date the amount appropriated for this harbor is $182,766.90, of which there had been expended to June 30, 1896—

For beach protection	$127,263.34
For dredging	50,514.89
Total	177,778.23

On June 30, 1896, the project for improvement had been completed. Long Beach was in good order.

On April 3, 1897, a plan and project for further improvement of the harbor were submitted, in accordance with the river and harbor act of June 3, 1896. This report and project were published as House Doc. No. 39, Fifty-fifth Congress, first session. They are also printed as Appendix B 29 of this report.

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In April, 1897, operations were commenced in the repair of breaches in Long Beach made by the storms of the winter of 1896–97. During the fiscal year 1,216.5 feet of bulkheads was built, and at the date of this report the beach is in good order.

July 1, 1896, balance unexpended	$4,988.67
June 30, 1897, amount expended during fiscal year	1,090.39
July 1, 1897, balance unexpended	3,898.28
July 1, 1897, outstanding liabilities	890.84
July 1, 1897, balance available	3,007.44

(See Appendix B 14.)

15. Harbor at Provincetown, Mass.—Provincetown Harbor is situated at the extremity of Cape Cod, about 40 miles southeast from Boston Light. It is one of the most valuable harbors of refuge on the Atlantic Coast. The entire commerce of New England and a very large local fishing interest are directly benefited by its maintenance, which depends entirely on the preservation of the sandy beaches which inclose it.

Since 1826 the project has been a general one, and provides for the preservation of the harbor by building dikes, bulkheads, and sand catches, and extensive planting of beach grass to repair or prevent storm damages to the beaches. From the nature of the work it can at no time be considered completed.

A full history of the improvement will be found in the Annual Reports of the Chief of Engineers for the years 1876, 1879, and 1886. A special dike across House Point Island Flats, to be built contingently, was recommended in the Annual Report for 1886.

A plan of the harbor was published in the Annual Report of the Chief of Engineers for 1886.

The total appropriations to date have been $155,918.44.

The amount expended to June 30, 1896, was $149,876.17.

At that date works of preservation had been built at Long Point, near Wood End Light, near Abel Hill, and at Beach Point, High Head, and Cove Section, and these works were all in good order, and fulfill the purpose for which they were built, excepting the section near Wood End Light.

In October, 1896, a survey of the harbor was made in accordance with the river and harbor act of June 3, 1896, and on March 1, 1897, a plan and report of the survey were submitted, with a project for strengthening the beach near Wood End Light, estimated to cost $13,200. This plan and report were published as House Doc. No. 8, Fifty-fifth Congress, first session; they are also submitted herewith as Appendix B 30.

No other operations were in progress during the fiscal year, and at the date of this report the beach and works of preservation are in good order, excepting the section near Wood End Light.

July 1, 1896, balance unexpended	$6,042.27
July 1, 1897, balance unexpended	6,042.27

(See Appendix B 15.)

16. Harbor at Chatham, Mass.—Chatham Harbor is at the eastern end of Nantucket Sound, about 15 miles east of Hyannis, Mass. Its outer anchorage (Chatham Roads) is a valuable harbor of refuge from northerly and easterly gales. The inner harbor (Stage Harbor) is small, but well landlocked, and has 8 to 12 feet depth at mean low water. Its entrance was obstructed by three bars, on which the greatest depth at mean low water was 4 feet.

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The project for the improvement of this harbor, submitted December 19, 1890, proposes to dredge a channel through the three obstructing bars 6 feet deep at mean low water—100 feet wide at the inner bar, 150 feet wide at the middle bar, and 200 feet wide at the outer bar—at a cost of $10,000.

The total appropriations to date have been $10,000.

The expenditure to June 30, 1896, was $4,402.15.

At that date the improved channel through the middle and inner bars was 100 feet wide, 6 feet deep at mean low water. Nothing had been done on the outer bar. At least 5 feet draft could be carried into the harbor at mean low water.

In this condition the improvement has facilitated the navigation of the harbor to a considerable extent.

The river and harbor act of June 3, 1896, appropriated $5,000 for this harbor, to complete the improvement.

On August 29, 1896, advertisement was published calling for bids for the proposed work, to be opened September 19, 1896. No bids were received in response to this advertisement.

On March 24, 1897, a revised estimate of cost of the project was submitted. This estimate increased the cost of the improvement $3,732.79, the increase being necessary because of the small amount of work to be done and the distance of Chatham Harbor from points where dredging plants are located. The funds available for the improvement are retained in the Treasury until further money is provided.

No other operations were in progress during the fiscal year, and at the date of this report the condition of the improvement is the same as on June 30, 1896.

The character of the commerce involved in the improvement is the local fishing interest and supplies of lumber, coal, etc., for local consumption. The value of the commerce annually approximates $200,000.

July 1, 1896, balance unexpended	$5,597.85
June 30, 1897, amount expended during fiscal year	23.95
July 1, 1897, balance unexpended	5,573.90
Amount (estimated) required for completion of existing project	3,732.79
Amount that can be profitably expended in fiscal year ending June 30, 1899	3,732.79
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix B 16.)

17. Removing sunken vessels or craft obstructing or endangering navigation.—On May 13, 1897, the wreck of the schooner *Annie E. Rudolph* was reported to be an obstruction to navigation, and on May 20, 1897, an allotment of $750 was made for the removal of her spars.

Public advertisement was issued under date of June 10, 1897, calling for proposals for the work; to be opened July 10, 1897.

(See Appendix B 17.)

EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The preliminary examinations and surveys of the following localities, required by the act of June 3, 1896, were made by the local engineer, Lieut. Col. S. M. Mansfield, Corps of Engineers, and reports thereon submitted:

1. Preliminary examination of Duxbury Harbor, Massachusetts, with a view to widening and deepening the improvement.—Lieutenant-Colonel

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Mansfield submitted report of examination February 15, 1897. It is his opinion, concurred in by the Chief of Engineers, that Duxbury Harbor is worthy of improvement by the General Government. No survey is necessary for the preparation of plan and estimate of cost of improvement proposed. The report was transmitted to Congress and printed in House Doc. No. 312, Fifty-fourth Congress, second session. (See also Appendix B 18.)

2. Preliminary examination of Duxbury Beach, Massachusetts, with a view to the protection of the harbor.—Lieutenant-Colonel Mansfield submitted report of examination February 15, 1897. It is his opinion, concurred in by the Chief of Engineers, that there is no necessity for strengthening the beach at present with a view of protecting the harbor of Duxbury. The report was transmitted to Congress and printed in House Doc. No. 313, Fifty-fourth Congress, second session. (See also Appendix B 19.)

3. Preliminary examination of Gurnet Rock and other rocks at mouth of Plymouth Harbor, Massachusetts.—Lieutenant-Colonel Mansfield submitted report of examination February 15, 1897. It is his opinion, concurred in by the Chief of Engineers, that the work necessary to afford additional facilities to navigation at this locality is not worthy of being undertaken by the General Government. The report was transmitted to Congress and printed in House Doc. No. 314, Fifty-fourth Congress, second session. (See also Appendix B 20.)

4. Preliminary examination of the approaches to the Cape Cod Ship Canal, Massachusetts.—Lieutenant-Colonel Mansfield submitted report of examination February 16, 1897. It appears from this report that there is no Cape Cod Ship Canal, and no charter in existence for the construction of one, and that its location, if such a waterway is ever opened, can only be conjectured. Under these circumstances it is impossible to state whether or not the approaches to such a canal would be work worthy to be undertaken by the General Government, but under present conditions action by the United States in the matter does not seem judicious. The report was transmitted to Congress and printed in House Doc. No. 311, Fifty-fourth Congress, second session. (See also Appendix B 21.)

5. Estimate of cost of improving Merrimac River, Massachusetts, by dredging channel thereof between Newburyport and Haverhill.—Lieutenant-Colonel Mansfield submitted report May 5, 1897, with estimate of cost of improving the Merrimac River by dredging the channel thereof betwen Newburyport and Haverhill of the width of 150 feet and of the depth of 7 feet at mean low water. He states that under previous appropriations this section of the river has been improved at Rocks Bridge, Curriers Shoal, both ends of Silbys Island, and between the bridges at Haverhill, and that the depth required renders improvement necessary only at the above-mentioned localities and at additional points, as follows: A small shoal about midway between the mouth of Powow River and Rocks Bridge; about 3,500 feet of channel between Rocks Bridge and Curriers Shoal, and a small shoal about midway between Curriers Shoal and Groveland Bridge. The cost of this work, including contingencies, is estimated to be $171,442.70. The report was transmitted to Congress and printed in House Doc. No. 52, Fifty-fifth Congress, first session. (See also Appendix B 22.)

6. Survey of Manchester Harbor, Massachusetts, with a view of securing a channel 8 feet deep at mean low water, 200 feet wide at the entrance, and 150 feet wide at and above Proctors Point to the town landing.—Lieutenant-Colonel Mansfield submitted report of survey April 7, 1897. The

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cost of the improvement proposed is estimated at $139,966.09; but in the opinion of the local officer the cost of this improvement is out of proportion to the benefits to be derived, and is not justified by the interests of commerce involved. The report was transmitted to Congress and printed in House Doc. No. 29, Fifty-fifth Congress, first session. (See also Appendix B 23.)

7. Survey of Manchester Harbor, Massachusetts (provided for by section 9 of the act of June 3, 1896).—In addition to the survey of Manchester Harbor with a view of securing channel widths of 200 and 150 feet and depth of 8 feet at mean low water, authorized by section 1 of the act of June 3, 1896, section 9 of the act made provision for a survey of the harbor in the discretion of the Secretary of War. The report on the former survey (see paragraph 6) was intended to comply with both provisions of the act, but it having been represented to the Secretary of War that a less extensive improvement would be satisfactory to the parties interested, the local officer was directed to present for the consideration of Congress an estimate of cost of such work as he might consider to be justified by the interests of commerce involved. Lieutenant-Colonel Mansfield submitted his report July 30, 1897. The plan of improvement proposed is to dredge the natural channel to a depth of 6 feet at mean low water for a length of 7,200 feet, to make it 100 feet wide at the entrance and at the sharp bends, and at least 75 feet wide throughout, with two turning or anchorage basins, one 200 feet by 300 feet in area just below the bridge and the other 125 feet by 250 feet near the town landing wharf. The estimated cost of this work is $25,000. (See Appendix B 24.)

8. Survey of Marblehead Harbor, Massachusetts, with a view to improving the harbor by building a sea wall to protect the isthmus connecting Marblehead Neck with the town of Marblehead.—Lieutenant-Colonel Mansfield submitted report of survey February 4, 1897. It is his opinion that there is no danger of the sea making a breach in the isthmus to the injury of the harbor. The report was transmitted to Congress and printed in House Doc. No. 289, Fifty-fourth Congress, second session. (See also Appendix B 25.)

9. Survey of Lynn Harbor, Massachusetts, with a view to securing a channel 300 feet wide and 15 feet deep at low water.—Lieutenant-Colonel Mansfield submitted report of survey March 29, 1897. The harbor is at present under improvement, and the plan now submitted for securing a channel of the dimensions named contemplates the further dredging of the outer and inner channels and the construction of a training wall. The cost of the proposed work is estimated at $441,813.07. It is the opinion of the local officer that the harbor is worthy of improvement to a certain extent, but not to the degree called for. The report was transmitted to Congress and printed in House Doc. No. 28, Fifty-fifth Congress, first session. (See also Appendix B 26.)

10. Survey of Weymouth (Back) River, Massachusetts, from Hingham Bridge to Mann's wharf.—Lieutenant-Colonel Mansfield submitted report of survey March 15, 1897. The plan of improvement presented provides for obtaining a channel 60 feet wide and 4 feet deep, with a view to accommodating the transportation of coal and building materials up to Mann's wharf. The proposed work is estimated to cost $49,834.01. The report was transmitted to Congress and printed in House Doc. No. 12, Fifty-fifth Congress, first session. (See also Appendix B 27.)

11. Survey of Neponset River, Massachusetts.—Lieutenant-Colonel

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Mansfield submitted report of survey April 17, 1897. The project of improvement presented provides for dredging the natural channel of the river so as to secure a depth of 10 feet at mean low water, with width of 150 feet, from the mouth to the railroad bridge at Neponset; thence 100 feet wide to the Neponset Highway Bridge; 100 feet wide and 6 feet deep thence to the Granite Bridge; at least 75 feet wide thence to the southerly corner of Godfrey's coal wharf in Milton; and 50 feet wide for a further distance of 250 feet. The cost is estimated at $35,000. The report was transmitted to Congress and printed in House Doc. No. 86, Fifty-fifth Congress, first session. (See also Appendix B 28.)

12. Survey of harbor at Plymouth, Mass.—Lieutenant-Colonel Mansfield submitted report of survey April 24, 1897. The harbor has been under improvement heretofore, and the further improvement now proposed is to provide, in the vicinity of the Middle Ground or Splitting Knife Shoals, where a sharp turn occurs, a channel 250 feet wide and 9 feet deep at mean low water to facilitate navigation, and to redredge the basin, all at an estimated cost, including contingencies, of $8,716.95. The local officer states that in his opinion the harbor is worthy of improvement, and the expense is justified by the interests of commerce involved. The report was transmitted to Congress and printed in House Doc. No. 39, Fifty-fifth Congress, first session. (See also Appendix B 29.)

13. Survey of Provincetown Harbor, Massachusetts, with a view of erecting a dike for the protection of that harbor.—Lieutenant-Colonel Mansfield submitted report of survey March 1, 1897. The plan submitted for the protection of the harbor provides for riprap along the inside of the narrowest part of the neck of sand connecting the mainland and Long Point, this location being, in his opinion, the proper one at present for the protection of the harbor. The cost of the proposed work is estimated at $13,200. The report was transmitted to Congress and printed in House Doc. No. 8, Fifty-fifth Congress, first session. (See also Appendix B 30.)

IMPROVEMENT OF RIVERS AND HARBORS IN SOUTHEASTERN MASSACHUSETTS AND IN RHODE ISLAND.

This district was in the charge of Maj. D. W. Lockwood, Corps of Engineers, with Lieut. Charles H. McKinstry, Corps of Engineers, under his immediate orders; Division Engineers, Col. (now Brig. Gen.) John M. Wilson, Corps of Engineers, to February 11, 1897, and Col. G. L. Gillespie, Corps of Engineers, since that date.

1. Harbor of refuge at Hyannis, Mass.—This harbor before improvement was an open roadstead, exposed to southerly storms. In the years 1827–1838 a breakwater of riprap granite 1,170 feet long was constructed, covering an anchorage of about 175 acres, the entrance to which has a depth of about 15.5 feet. Between the years 1852 and 1882 extensive repairs were made, increasing the width of its base and the size of the stone forming its sides and top.

The approved project of 1884 provides for the dredging to 15.5 feet depth at low water of about 36 acres area north of the existing breakwater, so as to increase the deep-water harborage by that amount; all at a total cost estimated in 1884 at $45,743.20.

At the adoption of the present project the 15.5 feet depth anchorage covered only about 47 acres, and the 36 additional acres to be dredged carried an average of about 12 feet depth of water at low water.

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The sum of $157,752.69 had been expended at this harbor up to June 30, 1896, of which $123,350.62 had been expended in construction and repairs to the breakwater and $34,402.07 in dredging in the anchorage area, by which 20 acres out of 36 had been dredged.

Fourteen thousand seven hundred and eighty-one cubic yards of mud and sand was dredged during the past fiscal year under contract, adding about 2 acres to the deepened anchorage area.

The principal value of this harbor to commerce is as a harbor of refuge for coasters and fishing vessels. About three thousand vessels of various kinds used the harbor last year. The actual commerce of the place consists of general agricultural products, coal, and fish, aggregating 24,220 tons. The increase of anchorage area will afford refuge for more and larger boats.

The balance available will be applied to increasing the dredged area.

July 1, 1896, balance unexpended	$9,179.13
Amount received from sales	20.68
	9,199.81
June 30, 1897, amount expended during fiscal year	2,996.95
July 1, 1897, balance unexpended	6,202.86
July 1, 1897, amount covered by uncompleted contracts	4,800.00
July 1, 1897, balance available	1,402.86
Amount (estimated) required for completion of existing project	2,162.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	2,162.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix C 1.)

2. Harbor of refuge at Nantucket, Mass.—This harbor is the only one between the harbor of Marthas Vineyard (Vineyard Haven and Edgartown) and Provincetown, a distance of about 100 miles, except the small harbor of Hyannis, on the north side of Nantucket Sound. It has a considerable area with a depth of water in excess of 12 feet, and the object of improvement is to make it a harbor of refuge for vessels plying between ports north and south of Cape Cod.

The approved project of 1880, as modified in 1885, provides for the construction of two jetties as training walls, one on each side of the harbor entrance, planned so as to allow the tidal currents to assist in scouring out and maintaining a good channel, and for the completion of the work by dredging where necessary to obtain a depth of from 12 to 15 feet at low water in this channel; all at a total cost estimated in 1885 at $375,000, of which $220,000 was appropriated prior to 1896.

At the adoption of the present project no jetties existed and the channel entrance was barred by a shoal of 1.5 miles width, on which there was only 6 feet depth of water at low tide, the channel being very crooked and subject to changes in location.

The sum of $259,145.12 had been expended on this work up to June 30, 1896, of which $45,734.75 had been expended in ineffectual dredging between 1829 and 1844, and the balance, $213,410.37, in jetty construction; by which the west jetty had been built to 3,955 feet length, with full height, the east jetty had been built to 834 feet length, with full height, then the foundation laid for a length of 191 feet, then came a gap of 160 feet, beyond which 1,300 feet length had been raised to half tide level, and then 2,145 feet length raised to 1.5 feet below the level of mean low tide, the total length from shore end to outer end being now 4,840 feet.

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During the past fiscal year 1,230 tons of stone was placed near the end of the east jetty, strengthening the end and supporting a lantern staff. During an unusually severe storm in December, 1896, a breach was made through the Haulover Beach between the ocean and the head of the harbor. Under supplemental articles of agreement with the contractor for jetty construction, it was decided to extend the western jetty rather than build up to full height portions of the east jetty. At the close of the fiscal year 1,650 tons of stone had been placed in this extension and the work was in progress.

Further work will consist in extending the west jetty.

The entire commerce of Nantucket Island is carried on at this harbor, amounting in 1896 to 14,488 tons. Five hundred and seventy-eight vessels entered and left it during this year. The effect on commerce of this work will be to afford a place of refuge easy of access and secure from storms for coasters and fishing vessels.

July 1, 1896, balance unexpended		$26,589.63
June 30, 1897, amount expended during fiscal year		3,881.41
July 1, 1897, balance unexpended		22,708.22
July 1, 1897, outstanding liabilities	$2,585.33	
July 1, 1897, amount covered by uncompleted contracts	16,441.60	
		20,026.93
July 1, 1897, balance available		2,681.29
Amount (estimated) required for completion of existing project		135,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix C 2.)

3. Marthas Vineyard inner harbor at Edgartown, Mass.—The inner harbor at Edgartown lies in the northern part of the waterway or strait that separates Chappaquiddick Island from the east end of Marthas Vineyard. It extends southward about 1.5 miles from Chappaquiddick Point, opposite Edgartown, and averages about one-fifth of a mile in width.

This harbor is so completely landlocked as to form a safe harbor for small vessels, but the contracted width of the entrance and the resulting velocity of the tidal currents make it difficult to pass through.

The approved project of 1889 provides for the removal to 10 feet depth at low water of a "middle ground" shoal in the central part of the inner harbor, at a total cost estimated in 1893 at $7,000, all of which was appropriated prior to 1896.

At the adoption of the present project the middle ground shoal carried only about 6 feet of water, and was a very troublesome obstruction.

The sum of $4,863.81 had been expended on this work up to June 30, 1896, by which about three-quarters of the shoal had been dredged to full depth.

During the year 6,485 cubic yards of sand and mud was dredged under contract, removing all of the middle ground shoal excepting about one-tenth of the area on its eastern side.

All funds being exhausted, no further work is contemplated.

The commerce of the port in 1896 amounted to 42,801 tons, and the dredging of the inner harbor will give increased facilities for anchorage.

July 1, 1896, balance unexpended	$2,136.19
June 30, 1897, amount expended during fiscal year	2,136.19

(See Appendix C 3.)

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4. Harbor at Vineyard Haven, Mass.—Vineyard Haven is a deep indentation in the northern shore of the island of Marthas Vineyard, on the southern side of Vineyard Sound. The approved project of 1887, as modified in 1889, provides for the protection of the "chops" (or headlands) from erosion and the intervening harbor from being filled by the eroded material, the whole to be done by means of stone sea walls and jetties to be built along the beach in front of the bluffs at both headlands. The total cost was estimated in 1889 at $60,000, of which $50,000 was appropriated prior to 1896.

At the adoption of the present project the headlands were gradually wearing away and the adjacent parts of the harbor were shoaling. No protection works were in existence.

The sum of $42,762.18 had been expended on this work up to June 30, 1896, by which there had been built a sea wall of 960 feet length and a jetty of 50 feet length and five small spurs extending back from the sea wall to the foot of the bluff at the East Chop, and at the West Chop a sea wall of 880 feet length, three jetties of 150, 135, and 280 feet length, a wharf, and a short breakwater of 60 feet length, completing over two-thirds of the needed work. The works so far constructed appear to have afforded the needed protection.

During the past fiscal year work was commenced under contract for the further construction of the riprap walls and jetties, and was in progress at the end of the year. Three hundred and eighty-eight tons of stone was placed on the West Chop.

The amount available will be applied to continuing the work of protection at both chops.

The commerce of the harbor in 1896 amounted to 62,515 tons. The benefit to commerce of this work is the preservation of the anchorage area and harbor generally from shoaling.

July 1, 1896, balance unexpended		$14,237.82
June 30, 1897, amount expended during fiscal year		71.12
July 1, 1897, balance unexpended		14,166.70
July 1, 1897, outstanding liabilities	$872.15	
July 1, 1897, amount covered by uncompleted contracts	11,243.40	
		12,115.55
July 1, 1897, balance available		2,051.15
Amount (estimated) required for completion of existing project		3,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		3,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix C 4.)

5. Woods Hole Channel, Massachusetts.—Woods Hole is a waterway or strait connecting Buzzards Bay and Vineyard Sound and lying near the southwestern part of Cape Cod, Massachusetts. The name is also applied to the village and harbor in the near vicinity.

Before improvement the entrance to Little Harbor was obstructed by a bar with but 7.5 feet on it at mean low tide. Great Harbor has ample depth. In the strait the channels were crooked and obstructed by bowlders, and the velocity of the currents at certain stages of the tide was from 4 to 5 miles per hour. The site of the wharves and basins of the United States Fish Commission and Revenue Marine was a submerged point of land extending from the shore of the harbor.

The project of 1879 provided for making a channel through the bar at the entrance to Little Harbor and widening and deepening the channel through the strait. The project of 1883, extended in 1884 and 1886,

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provided for the construction of retaining walls on shore, a stone pier, and a wooden wharf, mainly for the use of the United States Fish Commission, and incidentally for the use of the other branches of the public service, all of which work had been completed prior to 1889. The project of 1895, the present approved project, provided for deepening the channel through the strait to 13 feet at mean low water and widening same to 300 feet, estimated to cost $396,000.

The amount expended on this work prior to the present fiscal year was $113,599.92, with which the entrance to Little Harbor had been dredged to 10 feet depth, and a direct channel to 9 feet depth had been dredged through the strait where none previously existed; the retaining walls, stone pier, and wooden wharves had also all been built and repaired.

During the past fiscal year a contract has been entered into for the deepening and widening of a direct channel through the strait.

The commerce of Woods Hole was 13,549 tons for 1896, no account being kept of vessels passing through the strait. The deepening of this channel will result in more vessels using it than formerly.

July 1, 1896, balance unexpended		$20,000.00
June 30, 1897, amount expended during fiscal year		21.99
July 1, 1897, balance unexpended		19,978.01
July 1, 1897, outstanding liabilities	$0.50	
July 1, 1897, amount covered by uncompleted contracts	18,000.00	
		18,000.50
July 1, 1897, balance available		1,977.51

Amount (estimated) required for completion of existing project	376,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	150,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix C 5.)

6. New Bedford Harbor, Massachusetts.—New Bedford Harbor is an estuary of Buzzards Bay, and is the port of the cities of New Bedford and Fairhaven.

Before improvement the channel had a depth of 12.5 feet at mean low water. The projects of 1874 and 1877 provided for a channel 300 feet wide and 15 feet deep at mean low water from the deep water just above Palmers Island to the wharves of New Bedford. This work was completed in 1877 at a cost of $20,000.

The project of 1887 provided for a channel 200 feet wide and 18 feet deep from Buzzards Bay to New Bedford at an estimated cost of $35,000, which has been completed.

The approved project of 1895, under which work is now being carried on, provides for dredging an anchorage area one-half mile long, 600 feet wide, and 18 feet deep at mean low tide on the north side of the channel leading from Fairhaven to New Bedford, at an estimated cost of $57,689.33.

At the adoption of the present project the anchorage area was from 12 to 18 feet deep.

The sum of $70,387.99 had been expended on this work up to June 30, 1896, by which a channel 200 feet wide and 18 feet deep at mean low tide had been secured from the deep water of Buzzards Bay to New Bedford.

During the past year 68,887 cubic yards of material was removed from the proposed new anchorage area, adding about 11 acres to the 18-foot anchorage.

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There were 6,445 vessels in the harbor during the year 1896, with a total tonnage of 841,950. The effect of the deep water on commerce is the use of deeper-draft vessels than formerly, larger cargoes, and a consequent reduction in water freight charges.

July 1, 1896, balance unexpended	$12,303.38
Amount received from sales	9.00
	12,312.38
June 30, 1897, amount expended during fiscal year	10,255.09
July 1, 1897, balance unexpended	2,057.29
July 1, 1897, outstanding liabilities	1,942.26
July 1, 1897, balance available	115.03
Amount (estimated) required for completion of existing project	47,689.33
Amount that can be profitably expended in fiscal year ending June 30, 1899	47,689.33
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix C 6.)

7. Canapitsit Channel, Massachusetts.—This waterway lies about 20 miles south of New Bedford, running between the islands of Cuttyhunk and Nashawena, and connecting the waters of Vineyard Sound and Buzzards Bay.

The object of the improvement is to make this channel safe for the use of light-draft sail boats, and also especially of the surf boats belonging to the life-saving station of this dangerous locality.

The approved project of 1891 provides for the widening and deepening of the present channel from Vineyard Sound to Buzzards Bay between the islands of Nashawena and Cuttyhunk, Massachusetts, so as to secure a depth of 6 feet at low water, with a least width of 150 feet over its entire length, at a total cost estimated in 1893 at $9,800, all of which had been appropriated prior to 1895.

At the adoption of the present project the sand shoals, and especially the numerous bowlders, made this passage specially dangerous to the life-saving station boats and other shallow-draft row and sail boats.

The sum of $5,236.04 had been expended on this work up to June 30, 1896, by which a channel of about 66 feet width and at least 5 feet depth at low water had been cut entirely across the shoal, completing about half of the proposed work.

During the past fiscal year the work of dredging was commenced and was in progress at the close of the year. But little progress has as yet been made.

The balance available will be applied to completing the project.

The number of vessels passing through this channel is reported as 2,365, and the commerce at Cuttyhunk at 2,921 tons.

July 1, 1896, balance unexpended		$4,563.96
July 1, 1897, balance unexpended		4,563.96
July 1, 1897, outstanding liabilities	$107.38	
July 1, 1897, amount covered by uncompleted contracts	3,500.00	
		3,607.38
July 1, 1897, balance available		956.58

(See Appendix C 7.)

8. Taunton River, Massachusetts.—This river rises in Norfolk County, Mass., and empties into Narragansett Bay at Fall River. The object of the improvement is to deepen and widen the channel leading to the

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city of Taunton, at the head of navigation, so that vessels of 11 feet draft can reach the city at high water.

In its original condition the channel was narrow and obstructed by bowlders, and from Berkley Bridge to Taunton the depth was not in places more than 5 feet at mean high water. A vessel of 30 tons burden was as large as could go up to Taunton.

From 1870 to 1879 $63,000 was appropriated to secure 9 feet depth at high water. This work was completed in 1879.

The approved project of 1880 provides for the widening and deepening of the river so as to secure a channel of at least 12 feet depth at high water, with 100 feet width from its mouth up to Berkley Bridge (above Dighton), thence 12 feet depth with 80 feet width (100 feet width at bends) up to Briggs Shoal, thence 11 feet depth with 80 feet width up to the shipyard, thence 11 feet depth with 60 feet width up to Weir Bridge, Taunton; all at a total cost estimated in 1893 at $125,000, of which $113,000 was appropriated prior to 1896.

At the adoption of the present project the channel was limited to 9 feet at high water and was too narrow and too much obstructed by bowlders for easy navigation by the craft making use of it.

The sum of $175,929.77 had been expended on this work up to June 30, 1896, by which a large part of the proposed work had been done, especially at the places most complained of by vessels using this river. Vessels of 11 feet draft could reach Taunton, at the head of navigation.

Expenditures during the past fiscal year were applied in removing the shoal near the mouth of Three Mile River and widening the channel through the Needles. To complete the existing project, dredging is required at a few points in the Needles and lower down the river, to widen and straighten the channel, and the removal of a small amount of ledge rock.

The balance on hand will be held until further appropriation is made.

The work done has enabled larger vessels to go up the river. The tonnage for 1896 was 500,000, showing an increase over previous years.

July 1, 1896, balance unexpended	$5,070.23
June 30, 1897, amount expended during fiscal year	4,580.34
July 1, 1897, balance unexpended	489.89
Amount (estimated) required for completion of existing project	7,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	7,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix C 8.)

9. Sakonnet River, Rhode Island.—Sakonnet River is an arm of the sea between the island of Rhode Island and the mainland, extending from the ocean to Narragansett Bay around the head of Rhode Island. It is at present obstructed at its upper end by two causeways extending across it; these causeways have draw openings which are of insufficient width and depth for the needs of commerce, and besides offer such obstruction to the ebb and flow of the tides that the currents through them make the passage dangerous even to boats of such dimensions as could pass through them under ordinary circumstances.

The present approved project provides for increasing the width and depth of the draw opening in the Stone Bridge, owned by the State of Rhode Island, so as to provide an opening 100 feet wide and 25 feet deep at mean low water, estimated to cost $40,000.

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July 1, 1896, balance unexpended	$20,000.00
July 1, 1897, balance unexpended	20,000.00
Amount (estimated) required for completion of existing project	20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix C 9.)

10. Pawtucket River, Rhode Island.—This river, otherwise called Seekonk River, is the upper portion of Providence River, and extends from Pawtucket to Providence. Before improvement the channel in the river had a ruling depth of about 5 feet at mean low water.

Between 1867 and 1873, $52,000 was appropriated to dredge the channel to 7 feet depth. This work was finished in 1876.

The approved project of 1883 provides for the deepening of the river so as to secure a channel of at least 12 feet depth at low water, with 100 feet width from its mouth at Providence up to opposite Grant & Co.'s wharf at Pawtucket, and thence 12 feet depth with 40 feet width through a stone ledge for a short distance farther to Pawtucket Bridge; all at a total cost estimated in 1883 at $382,500, of which $205,000 was appropriated prior to 1895.

At the adoption of the present project the channel was narrow and only about 5 feet deep.

The sum of $248,776.07 had been expended on this work up to June 30, 1896, by which the shoalest places in the lower section had been improved, securing a channel about 12 feet deep and 100 feet wide up to above the lower wharves of the city of Pawtucket; and at the head of the river the depth had been increased at low water over the entire ledge, two contracts being in force to effect this.

During the fiscal year work was in progress through the lower section of ledge rock, and the channel was completed to full width of 40 feet and depth of 12 feet. Work was also commenced on the upper section of the ledge rock and was in progress at the close of the fiscal year.

The effect of the improvement will be to cause the use of vessels of deeper draft than formerly, larger cargoes, and cheaper rates. The completed portion of the channel has already been a great benefit to the commerce of the river, which in 1896 amounted to a tonnage of 201,500.

The work yet to be done is to straighten the channel in its lower portions and to deepen the channel through the ledge to full depth with a width of 40 feet.

July 1, 1896, balance unexpended		$28,723.93
Amount received from sales		19.59
		28,743.52
June 30, 1897, amount expended during fiscal year		5,172.32
July 1, 1897, balance unexpended		23,571.20
July 1, 1897, outstanding liabilities	$175.50	
July 1, 1897, amount covered by uncompleted contracts	8,658.00	
		8,833.50
July 1, 1897, balance available		14,737.70
Amount (estimated) required for completion of existing project		157,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix C 10.)

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11. Providence River and Narragansett Bay, Rhode Island.—The object of this improvement is to furnish a wide and deep channel for foreign and coastwise commerce from the ocean to Providence.

Before the improvement of the river was commenced in 1853 many shoals obstructed navigation, and at one point in the channel, a place called "The Crook," the available low-water depth was but 4.5 feet. Between 1852 and 1873, $56,500 was appropriated, to secure first 9 and then 12 feet depth of channel. This work was finished in 1873.

The approved project of 1878, as modified in 1882, provides for the deepening of the river and the deepening and widening of its anchorage basins, so as to secure a channel of at least 25 feet depth at low water with 300 feet width from the deep water of Narragansett Bay up to Providence, R. I., and so as to secure anchorage basins of 20 feet depth with 600 feet width, 18 feet depth with 725 feet width, 12 feet depth with 940 feet width, and 6 feet depth with 1,060 feet width from Fox Point to Field Point; all at a total cost estimated in 1882 at $675,000, of which $627,500 was appropriated prior to 1896.

At the adoption of this project the channel was limited to 12-foot depths, and the anchorage areas were much too small and shallow for the craft seeking them.

The river and harbor act of June 3, 1896, provides for securing a ship channel 400 feet in width and of a depth of 25 feet at mean low water from Sassafras Point, in Providence Harbor, through Providence River and Narragansett Bay by the most direct route practicable to the ocean, by way of the "Western Passage," so called, at an estimated cost of $732,820.

The item in the act is as follows:

> Improving Providence River and Narragansett Bay, Rhode Island: Continuing improvement, according to the report of the Chief of Engineers, dated April ninth, eighteen hundred and ninety-six, twenty-five thousand dollars: *Provided*, That contracts may be entered into by the Secretary of War for such materials and work as may be necessary for the completion of such project, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate seven hundred and seven thousand dollars, exclusive of the amount herein and heretofore appropriated.

The sum of $686,728.14 had been expended on this work up to June 30, 1896, by which Bulkhead Rock had been removed and the channel 300 feet wide and 25 feet deep had been secured to the city of Providence, and an anchorage area 1,060 feet wide, with depths varying from 6 to 20 feet, had been dredged, but both the channel and anchorage now need some redredging.

A contract is in force for dredging the river channel between Sassafras and Conimicut points. No contract has yet been made for work in the Western Passage.

During the past fiscal year a survey covering the proposed new 400-foot channel was made between Sassafras Point and Conimicut Point, and 145,372 cubic yards of mud was removed from the channel.

The balance available will be applied to continuing the dredging in the new ship channel.

The improvement has been of great benefit to commerce, which has increased over past years. Nineteen thousand three hundred vessels of all classes have entered this river, carrying a total tonnage of 1,600,950.

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July 1, 1896, balance unexpended		$29,771.86
Received from sale of material		143.39
Amount appropriated by sundry civil act approved June 4, 1897		125,000.00
		154,915.25
June 30, 1897, amount expended during fiscal year		11,762.46
July 1, 1897, balance unexpended		143,152.79
July 1, 1897, outstanding liabilities	$6,715.26	
July 1, 1897, amount covered by uncompleted contracts	7,098.23	
		13,813.49
July 1, 1897, balance available		129,339.30

Amount (estimated) required for completion of existing project	582,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	400,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix C 11.)

12. Removal of Green Jacket Shoal, Providence, R. I.—This shoal is in that part of Providence River which constitutes the harbor of Providence. It lies off the wharves, on the south front of the city, and occupies a part of the harbor that is required for anchorage purposes, covering an area of about 18 acres between the 15-foot curves and about 30 acres in all.

The approved project of 1885 provides for the removal, to 25 feet depth at low water, of a middle-ground shoal of about 30 acres area in Providence River, opposite the city, the portion to be removed to be at least 200 feet distant from the harbor lines of the city; all at a total cost estimated in 1885 at $112,346, of which $96,250 was appropriated prior to 1896.

At the adoption of the present project the shoal in many places carried only 1 foot of water and was a very troublesome obstruction.

The sum of $95,983.19 had been expended on this work up to June 30, 1896, by which 22 acres out of the original 30 of this shoal had been dredged to 25 feet depth, and a 16-foot depth had been secured over the central and largest portion of the shoal, in addition to a 20-foot depth in the main channel, making an important addition to the anchorage facilities of Providence Harbor.

During the past fiscal year 39,951 cubic yards of mud was removed from the southern part of this shoal, adding about 1.8 acres to the deepened area, at a cost of $7,913.80.

The removal of this shoal will enable vessels to anchor outside of the channel and thus remove an obstruction to vessels going to or from the Providence wharves.

July 1, 1896, balance unexpended	$8,266.81
June 30, 1897, amount expended during fiscal year	7,913.80
July 1, 1897, balance unexpended	353.01
July 1, 1897, outstanding liabilities	20.75
July 1, 1897, balance available	332.26

Amount (estimated) required for completion of existing project	8,096.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	8,096.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix C 12.)

13. Harbor at Wickford, R. I.—Wickford Harbor is an arm of Narragansett Bay, about 18 miles south of Providence and 12 miles northwest of Newport. It is the water terminus of the Wickford Railroad,

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which connects with the New York, New Haven and Hartford Railroad at Wickford Junction, and in connection with a ferry route from Wickford to Newport forms the shortest line of communication between Newport and New York and other points west.

The present approved project of 1896 provides for the removal of certain bowlders and deepening the harbor by dredging.

The sum of $10,000 had been expended on this improvement up to June 30, 1896, which removed some of the bowlders from the entrance to the harbor, and gave a channel of 9 feet depth at mean low water up to the steamboat wharf near the entrance, but the channel up to the wharves of the town of Wickford was winding and about 6 feet deep.

Expenditures during the past fiscal year were applied in removing 30,265 cubic yards of mud and clay, and two-thirds of a cubic yard of bowlders from the entrance channel and the channel leading to the town, giving a least depth of 9 feet at mean low water and width of 60 feet to the town wharves.

The money available is to be applied to removing a few additional bowlders.

July 1, 1896, balance unexpended	$6,300.00
June 30, 1897, amount expended during fiscal year	5,563.89
July 1, 1897, balance unexpended	736.11

(See Appendix C 13.)

14. Newport Harbor, Rhode Island.—This harbor is at the main entrance to Narragansett Bay, and all the year it serves as an easily accessible harbor of refuge to foreign and coastwise commerce.

Before improvement the capacity of the inner harbor was limited by shoals, and it was not adequate to the number and size of the vessels seeking it for refuge. The southern or main entrance was obstructed by a bar which stretched out from Goat Island, and the northern entrance by a sharp, rocky spit near Rose Island, and the general business wharves of the city could not be reached at low tide by vessels drawing more than 8 feet.

Between 1873 and 1875 $28,500 was appropriated to secure 12 feet depth in the harbor. This work was completed in 1876.

The approved project of 1880, as modified in 1882, 1883, 1884, 1890, and 1895, provides for the widening and deepening of the channel from Narragansett Bay into Newport, so as to secure 15 feet depth at low water with at least 750 feet width; for the extension of the 13 foot depth and 10-foot depth anchorage basins; for the partial cutting off of the shoal spit at the southern end of Goat Island, and for the construction of jetties on the western shore of Goat Island so as to protect the end of this island from erosion and to prevent the drift of sand, etc., around the island into the adjacent parts of the channel and harbor, and the removal of Spindle Rock, a sharp, rocky spit near Rose Island; all at a total cost estimated in 1895 at $206,200, of which $137,000 was appropriated prior to 1895.

At the adoption of the present project this harbor was limited to 12 feet depth at low water, and its anchorage area was too small for the craft seeking harborage at this place during the summer and all the year during storms.

The sum of $160,223.86 had been expended on this work up to June 30, 1896, by which the 15-foot channels and 13-foot anchorage basins had been dredged, the shoal spit at the southern end of Goat Island had been cut off, and one jetty 133 feet long had been built westward from Goat Island. The southern entrance had been completed for vessels of

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15 feet draft, and of the total area to be dredged within the harbor (about 90 acres) about 75.25 acres had been completed, and 194 cubic yards of rock had been removed from Spindle Rock.

Expenditures during the past fiscal year were applied in removing 215 cubic yards from Spindle Rock, and 38,715 cubic yards of clay and mud from near the southern end of Goat Island, completing the channel to full width and depth.

The work required to complete the existing projects is the excavation of a small remaining portion of the 10-foot anchorage area; also the building of additional jetties outside of Goat Island, whenever they may be required, to arrest the drift of littoral sand and gravel into the harbor entrance.

As the improvement of this harbor has progressed there has been a large increase in the size and number of vessels using the harbor. The commerce for 1896 shows a tonnage of 413,880, principally fish, coal, and general merchandise.

July 1, 1896, balance unexpended	$20,276.14
Amount received from sales	8.52
	20,284.66
June 30, 1897, amount expended during fiscal year	20,198.94
July 1, 1897, balance unexpended	85.72
Amount (estimated) required for completion of existing project	54,200.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	54,200.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix C 14.)

15. Harbor of refuge at Point Judith, Rhode Island.—Point Judith is the southeastern extremity of South Kingston, R. I., and marks the southwestern entrance to Narragansett Bay. A long ledge, known as Squid Ledge, extends for nearly a mile in a south by easterly direction, about 1.5 miles west of the point.

The approved project of 1889 provides for the construction of a national harbor of refuge, nearly a mile square at this point, by means of stone breakwaters, built partly on Squid Ledge and planned so as to give protection against easterly, southerly, and westerly storms, the mainland itself forming a protection on the north, all at a total cost estimated in 1889 at $1,250,000, all of which has been appropriated.

By the act of July 13, 1892, authority was given to the Secretary of War to make contracts for the completion of the project, on the basis of the above-estimated total cost, the work to be paid for as appropriations may from time to time be made by law.

At the adoption of the project this point was a specially dangerous place for boats and tows to pass during storms and even ordinarily bad weather.

The sum of $628,785.18 had been expended on this work up to June 30, 1896, by which the breakwater had been commenced at its center, extended to a total length of about 5,760 feet on the bottom, and about 4,800 feet length, raised well above high-water level, most of it to full height and three beacon lights established thereon.

During the past fiscal year 111,681 tons of stone was placed in the breakwater, making 635,022 tons in all. A length of 3,860 feet of the eastern arm of the breakwater was built up to full height and width, but the sea slope was not entirely completed.

It is reported that over 68,000 vessels passed the harbor during the year 1896, with a tonnage of 33,380,000.

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The limit of cost of this improvement, as fixed by law, was based on an estimate prepared in 1889 from the best information then available. Experience and additional information gained since that time showed that if the breakwater was to be completed to the extent proposed, the original estimate must be revised and materially increased.

The total amount of the original estimated cost having been appropriated, an estimate of $444,310.98 is submitted as the additional sum that will be required to complete the breakwater.

It is proposed to apply the balance available to continuing the construction of the breakwater.

July 1, 1896, balance unexpended		$321,214.82
Received from sale of material		38.61
Amount appropriated by sundry civil act approved June 4, 1897		300,000.00
		621,253.43
June 30, 1897, amount expended during fiscal year		271,308.64
July 1, 1897, balance unexpended		349,944.79
July 1, 1897, outstanding liabilities	$20,314.50	
July 1, 1897, amount covered by uncompleted contracts	22,949.05	
		43,263.55
July 1, 1897, balance available		306,681.24

Amount (estimated) required for completion of existing project	444,310.98
Amount that can be profitably expended in fiscal year ending June 30, 1899	444,310.98
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix C 15.)

16. Entrance to Point Judith Pond, Rhode Island.—Point Judith Pond is a shallow-draft salt pond, lying in rear of the sandy beach of the Rhode Island shore, just west of Point Judith.

The improvement desired at this place by the people of the neighborhood is the reopening of an old entrance long ago closed by the ocean storms.

The present entrance to this pond is very shallow (less than 3 feet), crooked, and variable in location, and lies about a mile west of the former entrance.

There is at present no approved project for the improvement of this pond entrance.

Up to June 30, 1897, $518.38 had been expended in surveys.

July 1, 1896, balance unexpended	$9,481.62
July 1, 1897, balance unexpended	9,481.62

(See Appendix C 16.)

17. Harbor of refuge at Block Island, Rhode Island.—This island is about 14 miles east of the eastern end of Long Island, and about 10 miles distant from the nearest point of the mainland.

The object of the improvement is to furnish a harbor of refuge for medium-draft vessels engaged in foreign and coastwise commerce.

Before the construction of the present harbor Block Island had no harbor which afforded protection for decked vessels.

Between 1870 and 1876 $285,000 was appropriated for a breakwater for a harbor for medium-draft vessels, this work being completed in 1878. Between 1880 and 1882 $25,000 was appropriated for dredging an inner basin and the protection of the shore next the breakwater, this work being completed in 1884. In 1884 $15,000 was appropriated for additions to the old breakwater, this money being so spent and work completed in 1884–85.

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The approved project of 1884, as modified in 1888, provided for the construction of a harbor of refuge on the eastern side of the island, consisting of an enlarged inner harbor (or basin) 800 feet square for small vessels and an exterior harbor for larger ones, at a total cost estimated in 1888 at $75,000, of which $74,000 was appropriated prior to 1896. This project was practically completed in 1893.

The present approved project, that of 1895, based on the report of the survey ordered in the river and harbor act of August 18, 1894, provides for raising the entire breakwater to proper height and stopping sand leaks between certain points, and dredging the main inner harbor to a depth of 10 feet at an estimated cost of $83,985.

At the adoption of the present project this harbor was neither large enough nor well enough protected for the proper harborage of the craft seeking refuge at this place during storms and bad weather.

The sum of $400,575.17 had been expended on this work up to June 30, 1896, and under the project of 1888 the gap in the old breakwater had been filled up so as to make the breakwater of 1,900 feet total length; the sea walls of the inner harbor had been completed (except as to stone fender piers at the entrance); wooden fender piers had been built for present uses; the worst rocks and bowlders had been removed from the new inner harbor; the shoal west of the breakwater had been dredged to a depth of 9 feet from the steamboat wharf to within 100 feet of the north wall, and the entrance to the inner harbor, which had shoaled up from the drift of sand through the main breakwater, had been partially dredged to a depth of 12 feet and redredged to 10 feet depth.

During the past fiscal year it became necessary to again dredge the entrance to the inner harbor, which work was in progress at the close of the fiscal year.

It is proposed to hold the present balance to be applied to keeping the entrance clear by dredging.

The increase of depth at entrance has enabled a larger class of vessels to use the harbor, and since the completion of the breakwater a greater number of vessels use the harbor for refuge; in 1896 16,225 vessels used the harbor and the commerce amounted to 50,362 tons, an increase over previous years.

July 1, 1896, balance unexpended	$5,924.83
June 30, 1897, amount expended during fiscal year	1,249.19
July 1, 1897, balance unexpended	4,675.64
July 1, 1897, outstanding liabilities	882.71
July 1, 1897, balance available	3,792.93
Amount (estimated) required for completion of existing project	78,985.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	78,985.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix C 17.)

18. Great Salt Pond, Block Island, Rhode Island.—The Great Salt Pond is located about the center of Block Island, and contains a large anchorage area for deepest-draft vessels. The State of Rhode Island and town of New Shoreham have appropriated altogether $115,000 toward securing a channel connecting it with the ocean on the west. The channel, under the approved project of 1895, is to be 600 feet wide and to have a central depth of 25 feet for a width of 150 feet, sloping gradually to 12 feet in a width of 504 feet; the channel seaward to be

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protected on the south by a jetty extending to the 18-foot contour, and on the north by a jetty about 500 feet long.

With the funds appropriated by the local authorities a channel has been dredged 450 feet wide with a minimum width of 150 feet, carrying 12 feet depth at mean low tide; a jetty on the south side of the channel has been built out 837 feet, and on the north side about 250 feet from the shore.

During the fiscal year 25,701 tons of stone was placed in the south jetty, extending it out to the 18-foot curve. This jetty will be completed early in July.

There remains to complete the existing project the further dredging of the channel and construction of the north jetty.

July 1, 1896, balance unexpended		$40,000.00
June 30, 1897, amount expended during fiscal year		26,890.24
July 1, 1897, balance unexpended		13,109.76
July 1, 1897, outstanding liabilities	$8,564.45	
July 1, 1897, amount covered by uncompleted contracts	817.67	
		9,382.12
July 1, 1897, balance available		3,727.64
Amount (estimated) required for completion of existing project		57,567.94
Amount that can be profitably expended in fiscal year ending June 30, 1899		57,567.94
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix C 18.)

19. Removing sunken vessels or craft obstructing or endangering navigation.—1. Schooner Enterprise.—This schooner was wrecked and sunk during May, 1896, in Vineyard Sound, near Buoy 11 A, eastern end of Norton Shoal. Her removal was completed by the Government force and plant on July 14, 1896.

2. Wreck in Vineyard Sound, southeast of Bishop and Clerks Light.—An unknown wreck was reported in this locality March 13, 1897, and its removal accomplished on March 31 by hired labor and use of the Government plant.

The cost of the work on wrecks during the year was $448.14.

(See Appendix C 19.)

EXAMINATION AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The preliminary examination and surveys of the following localities, required by the act of June 3, 1896, were made by the local engineer, Maj. D. W. Lockwood, Corps of Engineers, and reports thereon submitted through the division engineer:

1. Preliminary examination for obtaining a channel through Conanicut Island, Narragansett Bay, Rhode Island.—Major Lockwood submitted report of examination March 4, 1897. For the reasons given he does not deem the locality worthy of improvement by the General Government. The views of Major Lockwood are concurred in by the division engineer, Col. G. L. Gillespie, Corps of Engineers, and by the Chief of Engineers. The report was transmitted to Congress and printed in House Doc. No. 3, Fifty-fifth Congress, first session. (See also Appendix C 20.)

2. Survey of channel in New Bedford Harbor, Massachusetts, leading to the bridge between that city and Fairhaven, with a view to determining what amount of dredging would be necessary to make the change in the

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draw in said bridge from the west to the east side of Fish Island practicable and advantageous.—Major Lockwood submitted report of survey December 23, 1896. In his opinion the channel leading to the proposed draw between Fish Island and Popes Island should be 250 feet wide and 18 feet deep at mean low water, and to excavate such a channel will require the removal of 74,000 cubic yards of material above the bridge and 118,000 cubic yards below the bridge. He estimates the cost, in round numbers, at $34,000. The views of the local officer were concurred in by the division engineer, Col. (now Brig. Gen.) John M. Wilson, Corps of Engineers. The report was transmitted to Congress and printed in House Doc. No. 146, Fifty-fourth Congress, second session. (See also Appendix C 21.)

3. Survey of Mount Hope Bay and Fall River Harbor, Massachusetts.—Major Lockwood submitted report of survey May 3, 1897. Two plans of improvement are presented, as follows:

a. To provide a channel 25 feet deep and 300 feet wide by dredging across the flats on the southern approach from Narragansett Bay to the city, and along the city front to the yacht-club dock, at an estimated cost of $175,411.94.

b. To provide a channel 25 feet deep and 300 feet wide along the city front between the Old Colony Wharf and deep water at the upper end of the city front, at an estimated cost of $58,060.47. This work is included in the larger estimate mentioned above.

The improvement contemplated by the latter project is deemed by Major Lockwood to be sufficient for the present needs of commerce; but the division engineer, Colonel Gillespie, states that in view of the facts as given he is of the opinion that the channel leading from the ocean to the wharves at Fall River should have a width of 300 feet and a depth of 25 feet at mean low water, and he therefore recommends for approval the more extended project presented by the local officer. The views of the division engineer are concurred in by the Chief of Engineers.

The report was transmitted to Congress and printed in House Doc. No. 56, Fifty-fifth Congress, first session. (See also Appendix C 22.)

4. Survey of Sakonnet Point, Rhode Island.—Major Lockwood submitted report of survey June 24, 1897. He states that Sakonnet Point furnishes the only landing near the ocean in this locality, it being of considerable local importance, particularly in summer, and, in his opinion, a breakwater would be of great advantage to the interests involved. The plan of improvement submitted provides for the extension, with rock and stone, of the present old work, referred to in the report, out to the rock nearly north of it, and the raising of the whole structure to 8 feet above mean low water, the top width to be 15 feet. The cost is estimated at $25,000. The views of the local officer are concurred in by the division engineer, Colonel Gillespie. The report was transmitted to Congress and printed in House Doc. No. 81, Fifty-fifth Congress, first session. (See also Appendix C 23.)

5. Survey of easterly breakwater to shore, Point Judith, at Point Judith harbor of refuge, Rhode Island.—Major Lockwood submitted report of survey April 14, 1897. The proposed easterly breakwater was intended to increase the sheltered area between the main breakwater and the shore, and its shore end was planned to be 900 feet from the beach. The present survey was made with a view to determining the cost of closing this interval, which is estimated to be, including contingencies, $187,558.80. In the opinion of the local officer the proposed improvement is not worthy of being undertaken by the United States, as the

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same is not justified by the interests of commerce involved, and this opinion is concurred in by the division engineer, Colonel Gillespie. The report was transmitted to Congress and printed in House Doc. No. 53, Fifty-fifth Congress, first session. (See also Appendix C 24.)

IMPROVEMENT OF RIVERS AND HARBORS IN CONNECTICUT; OF PAWCATUCK RIVER, RHODE ISLAND AND CONNECTICUT, AND OF CONNECTICUT RIVER, MASSACHUSETTS AND CONNECTICUT.

This district was in the charge of Maj. Smith S. Leach, Corps of Engineers, since August 5, 1896, having under his immediate orders Lieut. William J. Barden, Corps of Engineers, since June 16, 1897. Division Engineers, Col. (now Brig. Gen.) John M. Wilson, Corps of Engineers, to February 11, 1897, and Col. G. L. Gillespie, Corps of Engineers, since that date.

1. Pawcatuck River, Rhode Island and Connecticut.—[This work was in the charge of Maj. D. W. Lockwood, Corps of Engineers, until August 21, 1896.] The navigable part of the Pawcatuck River extends from the town of Westerly, R. I., to Little Narragansett Bay, and the object of the improvement is to deepen and widen this channel, which is 7¼ miles in length. For maps, see Report Chief of Engineers, 1879, page 314, and House Doc. No. 62, Fifty-fourth Congress, first session.

Before improvement the channel was crooked and obstructed by numerous shoals, on some of which there was but 15 inches of water at mean low water. The mean tidal oscillation is 2.6 feet at the mouth and 2.3 feet at Westerly.

Between 1871 and 1876 $50,000 was appropriated for the excavation of a channel 5½ feet deep at mean low water and 75 feet wide below the wharves, 6¾ miles, and from 35 to 40 feet wide between the upper and lower wharves, one-half mile, this work being completed in 1876.

The approved project of 1885 provided for the deepening and widening of the river so as to secure a channel of at least 8 feet depth at low water, with 100 feet width from its mouth up to the lower wharves of Westerly, 6¾ miles, and thence a channel of the same depth, with about 40 feet width, to the upper wharves of the city, one-half mile; all at a total cost estimated in 1891 at $42,400, and $48,400 has been appropriated for this project up to 1895.

The sum of $92,154.20 had been expended on this river up to June 30, 1895, by which the 8-foot channel had been completed from deep water upward with full width to within a half mile of the city and partial width for the remaining distance; and the rock ledge obstructions had been removed from about 3,000 feet length of the 40 foot channel between the wharves of Westerly and from about 1,000 feet length of the 100-foot channel below the city.

On June 30, 1896, the project of 1885 had been completed, at a total expense of $98,000.01, and a survey and estimates for a new project made by which the depth of channel was to be increased to 10 feet and the width of same up to Avondale increased to 200 feet, all at an estimated cost of $200,361.60. This project was presented in House Doc. No. 62, Fifty-fourth Congress, first session, and in the Annual Report of the Chief of Engineers for 1896, part 1, page 676. The effects of the improvement are the use of a larger class of vessels than formerly, larger cargoes, and cheaper freights on coal and lumber and other cargoes.

Under a contract in progress and another pending, the appropriation of 1896, $15,000, will be applied to the partial execution of this new project, beginning at the upper end.

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July 1, 1896, balance unexpended		$15,000.00
June 30, 1897, amount expended during fiscal year		1,970.95
July 1, 1897, balance unexpended		13,029.05
July 1, 1897, outstanding liabilities	$2,227.75	
July 1, 1897, amount covered by uncompleted contracts	8,173.00	
		10,400.75
July 1, 1897, balance available		2,628.30

Amount (estimated) required for completion of existing project	185,361.60
Amount that can be profitably expended in fiscal year ending June 30, 1899	25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix D 1.)

2. Harbor of refuge at Stonington, Conn.—[This work was in the charge of Maj. D. W. Lockwood, Corps of Engineers, until August 21, 1896.] Stonington Harbor lies on the north side of the Watch Hill entrance from the ocean into Long Island Sound, and its breakwaters are for the purpose of making the harbor a refuge for vessels entering and leaving this entrance. Stonington Harbor originally was an open bay, unprotected from southerly storms and obstructed by a shoal having a low-water depth of about 6 feet at the shoalest part. The mean tidal oscillation is 2.7 feet. Between 1827 and 1831 about $37,000 was spent in constructing piers or breakwaters in the inner harbor for the protection of the general anchorage. Between 1871 and 1873 $46,166 was appropriated for a survey and for dredging the harbor to 12 feet depth, this work being finished in 1875. Between 1875 and 1879 $112,500 was appropriated for the construction of a western breakwater about 2,000 feet long, extending to 18 feet depth of water, and for dredging the harbor to 12 feet depth inside this breakwater, this work being completed in 1880.

The approved project of 1880 provides for the construction of an eastern breakwater as a protection to the outer harbor; this breakwater, about half a mile long, to extend from the vicinity of Bartletts Reef to the vicinity of the Middle Ground Shoal, or until it gives sufficient protection to the harbor against southerly winds; all at a total cost estimated in 1884 at $143,000, and $148,000 has been appropriated up to 1896.

At the adoption of the present project the harbor had no eastern breakwater.

To June 30, 1896, $143,011.85 had been expended on the present project, completing 2,900 linear feet of the eastern breakwater. The sum of $184,408.83 had been expended on previous projects, including the western breakwater and dredging at the entrance of the harbor. A cut across Noyes Shoal had cost $4,187.22, making the aggregate expended to that date under projects for Stonington Harbor $331,607.90. For details of these projects see Report of Chief of Engineers, 1896, pages 663, 664.

During the fiscal year the appropriation of $5,000 in act of June 3, 1896, was in part applied to the construction of the sea wall around Stonington Point, as required by the act of Congress. The expenditure under this head was $3,352.77, which was made under contract, and completed all needful work for the protection of the point.

July 1, 1896, balance unexpended	$5,845.93
June 30, 1897, amount expended during fiscal year	3,352.77
July 1, 1897, balance unexpended	2,493.16

(See Appendix D 2.)

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3. Mystic River, Connecticut.—[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until August 5, 1896.] Mystic River is a narrow tidal stream in the eastern part of the State of Connecticut. The navigable part of the river extends in a general northeasterly direction for nearly 4 miles from Fishers Island Sound, past the villages of Noank, West Mystic, and Mystic, above which places it receives the discharge of several small fresh-water streams. The village of Mystic lies on both the east and west banks of the river, about 3 miles above Fishers Island Sound. At this point the river is crossed by a highway bridge with a draw. Nearly a half mile farther down is the drawbridge of the New York, New Haven and Hartford Railroad.

Directly opposite the mouth of the river lie Mystic, or Ram Island, and Ram Island Shoal, which cause the channel to divide and branch off sharply to the northeast and southwest. The northeast channel is 18 feet or more in depth and of sufficient width, but crooked; it is the one used by large vessels. The southwest channel opens out into a broad flat, with about 12 feet available depth.

The river channel up to within a half mile below the highway bridge had a natural low-water depth of 15 feet or more, shoaling to about 10½ feet near the bridge, where the channel was very narrow Its width in the lower part (from 80 to 300 feet) was sufficient, but there were several bends in its course, which made it somewhat difficult of navigation.

The mean rise of tide in Mystic River is 2½ feet.

Under act of Congress of August 11, 1888, a preliminary examination of Mystic River was made. In the report on this examination (Annual Report of the Chief of Engineers for 1889, part 1, p. 746), a project was submitted for dredging a channel 15 feet deep at mean low water and 100 feet wide, and for reducing five bends in the channel, at an estimated cost of $30,000.

This project was adopted under the river and harbor act of September 19, 1890, appropriating funds for beginning work.

Up to July 1, 1896, 139,634 cubic yards of sand and mud had been dredged. The channel of 15 feet depth and 100 feet width had been extended to the highway bridge at Mystic, the two upper of the bends had been widened as proposed, and the lower one partly as proposed, a change in the location of work there being necessitated by the uncovering of a ledge of rock at the middle of the bend, having about 9 feet depth at low water. No work had been done upon the third or fourth of the bends. Expenditures to the same date had been $23,328.01.

Commerce consists of local supplies, shipbuilding materials, etc., amounting to about 23,000 tons. The work done has rendered the transportation of these articles somewhat easier, but has not affected the amount.

The annual value is estimated at twelve times the estimated cost of the entire improvement.

A sketch of Mystic River was printed in the Annual Report of the Chief of Engineers for 1893, page 898.

The channel is completed, as designed, from the highway bridge at Mystic down to and including the second bend, 1¼ miles, being 15 feet deep at mean low water and 100 feet wide, with greater width, up to 300 feet, at the bends. At the third and fourth bends, opposite Sixpenny Island, no work has yet been done, and the 15-foot channel is from 125 to 300 feet wide. At the fifth or lowest bend the channel has been widened and is now from 150 to 250 feet wide. The ledge rock

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occurs at the sharpest part of the lowest bend and in the northeast side of the channel, and has a least depth (observed) of 8.8 feet. It covers an area of about 40 by 60 feet. The present width of the 15-foot channel at this point is 160 feet, and the rock has been marked by piles.

Under a pending contract the appropriation of 1896, $3,500, will be applied to dredging about 20,000 cubic yards from the lower bends. The project is advanced fully in the proportion of the aggregate appropriated by the original estimates and should be completed without exceeding the latter.

July 1, 1896, balance unexpended	$3,671.99
June 30, 1897, amount expended during fiscal year	403.78
July 1, 1897, balance unexpended	3,268.21
July 1, 1897, amount covered by uncompleted contracts	2,175.00
July 1, 1897, balance available	1,093.21
Amount (estimated) required for completion of existing project	3,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	3,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix D 3.)

4 Thames River, Connecticut.—[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until August 5, 1896.] This river is a tidal stream formed by the confluence of two small streams at Norwich, Conn., which is the head of navigation, and extends thence to Long Island Sound, a distance of 15 miles. For 11 miles above its mouth the river has a natural channel of 13 to 80 feet depth, but for the upper 4 miles the available depth was originally but 6 feet at mean low water. The tidal oscillation is 3.1 feet at Norwich and 2.5 feet at the mouth. The lower stretch of the river forms the harbor of New London. A railroad bridge with a draw of 500 feet clear span crosses the river just above New London. This bridge has two clear openings of 205 feet each.

Under an appropriation made in 1836 a project was adopted for making a channel 14 feet deep at high water (11 feet at low water) by dredging and by building dikes, at an estimated cost of $72,650. Work was stopped in 1839, by exhaustion of appropriations, before the project was completed.

Under an appropriation made in 1866 a project was adopted for dredging to make a channel of 11 feet depth at mean low water. This was modified in 1879 to make the depth 14 feet at mean low water, and in 1882 training walls were projected to maintain the channel, the width of which was placed at 200 feet. In compliance with the river and harbor acts of 1888 and 1892, the project was extended to provide for a depth of 16 feet up to Allyn Point, 5 miles below Norwich, and for a channel 100 feet wide with an anchorage basin adjacent, in Shaws Cove, New London, where the depth was to be 12 feet.

The present project therefore consists in making and maintaining by dredging and a system of training walls a channel 200 feet wide from New London to Norwich, to be 16 feet deep at mean low water to Allyn Point, and thence to Norwich, to be 14 feet deep, together with dredging in Shaws Cove, New London, to make a channel 100 feet wide and 12 feet deep and an anchorage basin of the same depth and of about 7½ acres area. The estimated cost from the beginning is $457,600.

Up to July 1, 1896, $367,454 had been expended under the present project. Three of the five proposed training walls had been completed

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and the fourth nearly so. The proposed river channel was completed to Allyn Point; thence to a point just below Norwich it had been made the full depth of 14 feet, with widths from 175 to 100 feet. The channel in Shaws Cove had been completed and the anchorage basin had been begun.

At the beginning of the fiscal year work was in progress under a contract for the extension of the 14-foot channel at its upper end. The contract was completed and closed on August 10, 1896, 32,797 yards having been taken out during the fiscal year. The channel reached the lower end of the lower dock at Norwich.

Harbor lines have been established in Shaws Cove, New London Harbor.

The latest published maps of the river will be found in the Report of the Chief of Engineers, 1894, page 628, and of Shaws Cove, 1893, page 904.

The estimated cost of maintaining the channel is approximately $8,000 per year.

Commerce at Norwich and Allyn Point consists mainly of coal, lumber, and other building materials, iron, and miscellaneous goods, amounting to about 406,000 tons. The work done has reduced the cost of transportation by enabling freight to be brought in vessels of 14 feet draft, instead of 8 feet. The river commerce of the present day could not have been carried without the increased depth. The annual value of river commerce is estimated at fifty to seventy-five times the estimated cost of the entire improvement.

Commerce in Shaws Cove consists mainly of lumber and coal, amounting to about 7,200 tons. Fishing steamers and pleasure boats use the cove for wintering and for fitting out in the spring. The work done has added materially to the convenience of this navigation, but has not noticeably affected its amount. The annual value of the commerce in Shaws Cove is estimated at about three-fourths the estimated cost of the entire improvement at this locality.

July 1, 1896, balance unexpended	$21,046.00
June 30, 1897, amount expended during fiscal year	9,021.34
July 1, 1897, balance unexpended	12,024.66
July 1, 1897, amount covered by uncompleted contracts	8,400.00
July 1, 1897, balance available	3,624.66
Amount (estimated) required for completion of existing project	69,100.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	40,000.00
Amount required for maintenance in fiscal year ending June 30, 1899	8,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix D 4.)

5. Connecticut River below Hartford, Conn.—[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until August 5, 1896.] The Connecticut River below Hartford is a large stream. For the first 21 miles it flows in a winding course, mostly through alluvial meadows, which are overflowed at high water, and which consist of a light, sandy soil, easily undermined. For the remaining 29 miles to Long Island Sound, at Saybrook Point, the course is straighter, the banks more permanent, and generally harder. A gauge has been established at Hartford whose zero is the lowest stage that the water is known to have reached from natural causes. Closing the gates at the Holyoke Dam in time of drought has caused the water to fall lower.

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The usual low-water stage of the river in the summer is about 1 foot on this gauge. Spring freshets ordinarily rise to 20 feet; the highest recorded stage of water is 29 feet.

The average tide at Saybrook is 3½ feet; at Hartford it is 1 foot, though when the water stands above 5 feet on the Hartford gauge the tide there is not perceptible. The low-water slope of the river from Hartford to Saybrook averages 0.0458 foot per mile. The bed of the river through the alluvial meadows within 10 miles of Hartford is constantly changing, from the undermining of the banks. It is said that in places it has changed its position a half mile. The bars in this part of the river, after being dredged, form again during freshets and ice jams, so that some of them require to be dredged annually, others less frequently. This part of the river was worked upon by corporations and by private parties at various times between 1800 and 1870. Several small stone piers to deepen the channel at shoal places were built in this way. Some of these are covered by new banks, the channel has shifted to the opposite side of others, and others still have been dredged out because they had come to be obstructions. The depth sought by these works was 6 feet at low water.

Before the beginning of improvements by the United States the available depth over Saybrook Bar was 7 feet at mean low water; thence to Hartford the available depth over the shoalest of the river bars was about 5 feet at low water, being generally at its minimum after the spring freshets, and increasing as the period of summer low water continued.

By act of July 4, 1836, Congress appropriated $20,000 "for improving the harbor at Saybrook by removing the bar at the mouth of the Connecticut River." A survey was made and a plan submitted for dredging a cut 500 feet wide and 12 feet deep at mean low water, at an estimated cost of $54,380.50. A channel was dredged 1,500 feet long, 50 feet wide, and from 11 to 12 feet deep in 1840; it almost completely filled up during the storms and freshets of the following winter and spring. No further appropriation was made for this project except to pay a balance due the contractors. By act of March 2, 1867, Congress ordered a survey of the Connecticut River, which was made that year, and which embraced the principal bars and obstructions between Hartford and Long Island Sound. The report upon this survey, printed in the Annual Report of the Chief of Engineers for 1868, page 754, presented a plan for improving the river below Hartford by dredging to make a channel 8 feet deep at low water and 100 feet wide in the river; 8½ feet deep and 200 feet wide at Saybrook Bar, at the mouth of the river; protecting the shore at Hartford and Wethersfield by piling, and removing Chester Rock, at a total estimated cost of $70,000, with an estimate of $10,000 as the annual cost of maintaining these channels. This project was adopted under authority of the river and harbor act of 1870, which made an appropriation for beginning the work.

In 1873 a project was adopted for improving the channel at Saybrook Bar, at the mouth of the river, by dredging and by building three jetties, at an estimated cost of $336,610. Two of the proposed jetties were completed in 1881, and the third was found to be unnecessary.

In 1880 a plan was adopted for permanent improvements at the worst six bars in the river by riprap wing dams or dikes, mattresses, shore protection, and rectification of the banks, at an estimated cost of $330,487. Dikes at Hartford and Glastonbury bars were built. In 1887, when it had become evident that these constructions would not sufficiently reduce the amount of dredging required each year, the plan was abandoned and the project of 1870 for annual dredging was

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reverted to, modified to provide for a depth of 9 feet at extreme low water, together with estimates for completing the Saybrook jetties and dredging between them, at an estimated cost of $80,000. This was modified in 1889 to include raising the Hartford Dike to 15 feet above low water, at an estimated cost of $50,000.

The present project is therefore the project of 1870, modified to provide for a channel from Long Island Sound to Hartford, Conn., to be 400 feet wide and 12 feet deep at mean low water across Saybrook Bar, and thence to Hartford to be 100 feet wide (or as nearly that as practicable), and 9 feet deep at extreme low water, or about 10 feet at ordinary summer low tide, the channels to be maintained by annual dredging in the river and by enlarging the Saybrook jetties and the Hartford Dike at an estimated cost—

For annual dredging	$10,000
For permanent work, which includes the dredging at Saybrook Bar (estimated in 1889)	130,000

The maintenance of navigable channels by annual dredging has been held paramount in the project, and is the only work of improvement done upon this river since 1887, the available funds at no time having been sufficient for enlarging the dike or Saybrook jetties or for additional dredging at Saybrook Bar. The jetties are constantly deteriorating, and are now in a condition demanding attention.

July 1, 1896, annual dredging was in progress to remove the shoals which had formed during the freshets of the preceding spring. Dredging was resumed near the close of the fiscal year to clear the channels after this year's flood, and is in progress at the date of this report. The annual dredging will usually be between May 20 and August 15.

Sketches of the Connecticut River from Hartford to Rocky Hill and of Saybrook Bar were printed in the Annual Report of the Chief of Engineers for 1885, page 636. The river from the Sound to Hartford is shown on Coast Survey charts 253, 254, 255, and 256.

Commerce consists mainly of coal, stone (shipped from Portland and vicinity), building materials, and miscellaneous freight, amounting to about 712,000 tons.

The work done and being done has reduced freights on these articles materially, and without the improvements there could be little commerce on the river.

The annual value of the commerce is estimated at over three thousand times the annual cost of maintaining the channels.

The total amount expended by the United States for this improvement from 1836 to July 1, 1896, was $443,762.93.

July 1, 1896, balance unexpended		$32,407.07
June 30, 1897, amount expended during fiscal year		12,482.68
July 1, 1897, balance unexpended		19,924.39
July 1, 1897, outstanding liabilities	$1,921.54	
July 1, 1897, amount covered by uncompleted contracts	7,081.56	
		9,003.10
July 1, 1897, balance available		10,921.29

Amount (estimated) required for completion of existing project	130,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	25,000.00
Amount (estimated) required for maintenance annually	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix D 5.)

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6. Harbor of refuge at Duck Island Harbor, Connecticut.—[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until August 5, 1896.] Duck Island Harbor is a bay on the north shore of Long Island Sound. It is about 7 miles west of the mouth of the Connecticut River and midway between the harbors of New Haven and New London. In this distance of 46 miles there is no harbor of sufficient size and depth to shelter any considerable part of the general commerce of the Sound. Duck Island Harbor has a large anchorage area, with depths of 16 feet or more at low tide, and with good holding bottom. It is sheltered from the north by the mainland, partly sheltered from the east by Menunketesuck Point, and slightly sheltered from the south by Duck Island, an island about 900 feet long (north and south) by 300 feet wide, situated in the mouth of the harbor, rather more than half a mile west-southwest from Menunketesuck Point. The mean tidal oscillation is 3.80 feet.

The project for this improvement, adopted by the river and harbor act of 1890, provides for the construction of three riprap breakwaters of 3,000, 1,750, and 1,130 feet length, respectively, inclosing and sheltering an area of about 115 acres, with two ample entrances. The adopted grade is 6 feet above high water with crown of 10 feet and slopes of 2 on 3 outside and 1 on 1 inside. The estimated aggregate cost is $463,540.

Work under this project was begun in May, 1891, and up to July 1, 1896, $82,215.16 had been expended, and 2,385 linear feet of the west breakwater had been built, extending westwardly from Duck Island to a depth of 17 feet. No work was done during the fiscal year. A light was maintained at end of the uncompleted structure.

Under the appropriation of $24,000 in act of June 3, 1896, a contract has been entered into for placing about 25,000 tons of riprap in the structure. The application of this appropriation will leave 3,000 linear feet completed and 2,880 linear feet projected.

The breakwater now affords a limited shelter from south and southeast storms, and is to some extent sought for that purpose.

The commerce to be benefited by this improvement is the passing commerce of Long Island Sound, which may find it convenient or necessary to seek shelter behind the breakwater during storms.

Its value can not be estimated with any accuracy.

The total amount appropriated for this improvement is $114,000. For map see Report of Chief of Engineers, 1887, page 644.

July 1, 1896, balance unexpended		$31,784.84
June 30, 1897, amount expended during fiscal year		9,458.29
July 1, 1897, balance unexpended		22,326.55
July 1, 1897, outstanding liabilities	$69.15	
July 1, 1897, amount covered by uncompleted contracts	16,250.00	
		16,319.15
July 1, 1897, balance available		6,007.40

Amount (estimated) required for completion of existing project 349,540.00
Amount that can be profitably expended in fiscal year ending June 30, 1899 ..... 100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix D 6.)

7. New Haven Harbor, Connecticut.—[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until August 5, 1896.] New Haven Harbor is a bay on the north shore of Long Island Sound, extending about 4 miles inland and from 1 to 2 miles wide. The Mill

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and Quinnipiac rivers empty into the head of the harbor from the northeast. They are navigable for about 1 and 2 miles, respectively, above their mouths. The mean range of tides is 6.1 feet.

The harbor channel is from 400 feet to a mile wide, with mud and sand flats on either side. When the Government began work in this harbor in 1867 the available low-water depth from the wharves to Cranes Bar, one-third way down the harbor, was 9 feet; thence to Fort Hale, halfway down, it was 16 feet or over. Just below Fort Hale was a broad shoal of very soft mud extending across the channel, with 13 feet available depth at mean low water. The harbor entrance was partly obstructed by several sunken rocks.

Several plans for removing certain of the rocks at the harbor entrance have been proposed, and work upon two of them was begun. Before they were completed the light-house was removed to Southwest Ledge, and the project for breakwater construction at the harbor entrance was adopted, using these rock shoals as a base and making their removal unnecessary.

Under the appropriation of 1871 the project was extended to include dredging a channel in the harbor. This was at first designed to be 13 feet deep at mean low water and 200 feet wide. When appropriations were made beyond what was required for completion of the project it was from time to time extended, and now consists in making a channel 16 feet deep at mean low water and from 400 to 700 feet wide from Tomlinson's bridge, at the head of the harbor, to Long Island Sound, by dredging and construction of a dike to contract the channel width over Fort Hale Bar, at an estimated cost from beginning of $348,000. Details concerning the several extensions of the project were printed in the Annual Report for 1895.

Up to July 1, 1896, under this project a dike had been built from Sandy Point to contract the channel width on Fort Hale Bar, the length of its channel arm, 2,089 feet, being about two-thirds the projected length; the channel up to the wharves had been made 16 feet deep at mean low water and from 400 to 700 feet wide, except across Fort Hale Bar, where the width is but 100 feet.

The total amount expended to July 1, 1896, was $315,011.36.

The commerce of New Haven consists mainly of coal, iron, lumber, and miscellaneous freights, aggregating about 3,300,000 tons per year. The increased depth resulting from the improvement has facilitated the transportation of these freights and lessened the delay for tides. A large part of the present commerce could not have been carried on without the improved channel.

The annual value of this commerce is estimated at about eight hundred and fifty times the entire cost of the improvement when completed.

Harbor lines for New Haven Harbor were established by the Secretary of War November 17, 1894, and were slightly modified and amended by him March 2, 1895, and May 20, 1895.

The last printed map of the harbor may be found in the Annual Report of the Chief of Engineers for 1896, page 702.

Under the existing project there remains only the widening of the channel over Fort Hale Bar by dredging, and the extension of the dike, if necessary. The revised project, if adopted, will involve dredging to greater depth.

No dredging was done during the fiscal year ending June 30, 1897. Under the appropriation of act of June 3, 1896, a resurvey of the harbor was made, a report upon which with a revised project appears elsewhere in this report. A contract was entered into for dredging

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under the project to widen the channel over Fort Hale Bar. Work under this contract has not begun. It is to be finished by December 31, 1897.

July 1, 1896, balance unexpended		$10,988.64
June 30, 1897, amount expended during fiscal year		1,761.78
July 1, 1897, balance unexpended		9,226.86
July 1, 1897, outstanding liabilities	$2.50	
July 1, 1897, amount covered by uncompleted contracts	7,200.00	
		7,202.50
July 1, 1897, balance available		2,024.36
Amount (estimated) required for completion of existing project		28,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		28,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix D 7.)

8. Breakwaters at New Haven, Conn.—[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until August 5, 1896.] New Haven is the only natural harbor of any considerable area and depth in Long Island Sound between New London Harbor, 45 miles east, and Huntington Bay, 32 miles southwest. At this point Long Island Sound is at its widest, and the broad, open mouth of the harbor left the anchorage grounds exposed to storms from a southerly quarter, so that vessels driven in by stress of weather were frequently obliged to cross Fort Hale Bar, going from 2 to 4 miles up the harbor, and to anchor in the dredged channel in order to reach secure shelter.

January 21, 1875, a resolution of the House of Representatives called "for a report from surveys already made in regard to the expediency and estimate of expense of a breakwater between the eastern shore of the entrance to said harbor [New Haven Harbor] and Southwest Ledge, so called, or such part of said distance as may be found most expedient or necessary for the protection of said harbor." In reply to this resolution a report was made January 27, 1875 (printed in the Annual Report of the Chief of Engineers for 1875, part 2, p. 251), with estimates for three different locations for the breakwater.

The river and harbor act of 1879 appropriated $30,000 for the "construction of a breakwater at New Haven, Conn." The several plans were referred to The Board of Engineers, whose report (printed in the Annual Report of the Chief of Engineers for 1880, p. 449) recommended two riprap breakwaters, each to be 12 feet wide on top, the top being 6 feet above mean high water, one to extend from Southwest Ledge to Quixes Ledge, a distance of 3,300 feet, and one 4,200 feet long, extending northwest and southeast and overlying Luddington Rock, the whole estimated to cost $1,311,134. This project was adopted, and under it the east breakwater was built.

The river and harbor act of 1888 authorized the relocation of the western breakwater, and a modification of the project was submitted in the Annual Report of 1889. The river and harbor act of 1890 appropriated $120,000 for "constructing breakwater at New Haven, Conn., in accordance with plans submitted by the Chief of Engineers in the report for 1889, page 678." The project for this work, thus modified, consists of making a harbor of refuge at the entrance to New Haven Harbor by constructing four breakwaters, one extending from Southwest Ledge to Quixes Ledge; one 5,000 feet long, extending from a point 1,000 feet north 54 degrees east from Luddington Rock, southwesterly across the rock; one about 4,200 feet long, extending

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northwesterly from a point 6,000 feet south 54 degrees west from Luddington Rock; and one about 1,200 feet long, extending southwesterly from Morgan Point on the east side of the harbor entrance. The estimated cost of the whole work from the beginning in 1879 was $2,151,134.

The anchorage outside of the bar which will be sheltered by this breakwater exceeds 2,000 acres, and has depth of 9 to 26 feet at mean low water.

Up to July 1, 1896, the breakwater from Southwest Ledge to Quixes Ledge had been completed, and the Luddington Rock breakwater had been made 4,500 feet long, and 400 feet of the west breakwater had been built. The total expenditures to this date had been $732,176.03. During the fiscal year a contract was made and executed, under which 100,676 tons of stone was added to the west breakwater, extending it to a total length of 1,490 feet.

A sketch of New Haven Harbor, showing the location of the breakwaters as contemplated under the existing project, was printed in the Annual Report of the Chief of Engineers for 1889, page 678, and the last printed sketch may be found in Annual Report for 1896, page 702.

The commerce benefited by this work is the passing commerce of Long Island Sound. During 1895, 151,356 vessels were observed passing the breakwaters, and 3,925 vessels were observed at anchor in the mouth of the harbor, where they were partly under their shelter.

No estimate of the value of this commerce can be made.

July 1, 1896, balance unexpended	$102,823.97
June 30, 1897, amount expended during fiscal year	98,700.28
July 1, 1897, balance unexpended	4,123.69
Amount (estimated) required for completion of existing project	1,316,134.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	200,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix D 8.)

9. Housatonic River, Connecticut.—[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until August 5, 1896.] The Housatonic is a long, shallow river running southward through Massachusetts and Connecticut, emptying into Long Island Sound just east of Stratford Point, about 15 miles southwest from New Haven. At Derby, 13 miles above its mouth, it receives the discharge of the Naugatuck, a small rapid river. This point, which has been regarded as the head of navigation, is nearly the head of tide water. About a mile above there is a dam across the Housatonic River, furnishing large water power. For at least 5 miles below Derby the water is always fresh.

The original depth on the worst bars in the river (six in number) was from 3.5 to 4.5 feet at mean low water; there was also a bar across the river's mouth with about 4 feet low-water depth. The mean rise of tide at Derby is 4.2 feet; at the mouth of the river it is about 6.2 feet.

By act of Congress of July 11, 1870, a survey of the Housatonic River was ordered. The report on the survey printed in the Annual Report of the Chief of Engineers for 1871, page 781, presented estimates for making a channel 7 feet deep at mean low water, to be 200 feet wide over the bar at the mouth of the river and 150 feet wide in

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the river, by dredging, removing Drews Rock, and building a jetty at Sow and Pigs Reef, the channel at the mouth to be protected on the east side by a breakwater; the estimated cost was $404,961, of which $368,475 was the estimated cost of the breakwater.

This project was adopted under the river and harbor act of 1871, which made an appropriation for beginning the work. Dredging was done on the several bars in the river, the jetty at Sow and Pigs Reef was built, and under a modification of the project a jetty was built at Drews Rock; the latter, however, caused a shoal to form below the rock, and in 1888 the rock was removed as originally proposed. Up to 1888 no work had been done upon the bar at the river's mouth. This was considered the most important work in the river, but the channel could not be permanently deepened until the breakwater was constructed, and funds sufficient for that work had not been appropriated. In 1885 and 1886 certain oyster growers, who wished to use dredged material for oyster beds, offered to dredge across the outer bar without expense to the United States; they removed 52,888 cubic yards of sand and shells, making a channel 70 feet wide and 9 feet deep. The first severe storm following completely filled the outer part of the channel.

In 1887 the estimates of cost were revised and the project modified, reducing the width of channel in the river to 100 feet and proposing a riprap breakwater to be built to half tide for the first 3,250 feet from shore, and thence for about 2,500 feet farther to be built to 6 feet above high water, at an estimated cost of $202,000. The reasons for this were presented in Senate Ex. Doc. No. 103, Fiftieth Congress, first session, and in the Annual Report of the Chief of Engineers for 1888, page 554. This modification of the project was adopted under the river and harbor act of 1888. In 1893 the project was further modified to provide for building a small dike below Stratford to reduce the amount of dredging required.

The present project for improvement is therefore the project of 1871, subsequently modified, and consists in making and maintaining a channel 7 feet deep at mean low water from Long Island Sound to the head of navigation, about 13 miles, to be 100 feet wide in the river and 200 feet wide over the bar at the mouth, by dredging, removing Drews Rock, building a jetty at Sow and Pigs Reef and a small dike at the bend below Stratford, and protecting the channel at the mouth of the river by a breakwater about 5,750 feet long. The estimated cost, from the beginning in 1871, is $275,500.

July 1, 1896, Drews Rock had been removed, the jetty at Sow and Pigs Reef had been built, the dike below Stratford had been made 555 feet long, and the breakwater at the river's mouth had been made 5,821 feet long, the 3,250 feet nearest shore being built to about half-tide level and the outer part being built 4 feet above high water. Dredging had been done on the several bars in the river and at the mouth; the former had shoaled to a depth of 4 feet, but at the mouth the channel was 8 feet deep and 150 feet wide, all at a total cost of $180,868.22.

Sketches of the Housatonic River have been printed in the annual reports of the Chief of Engineers as follows: The whole navigable part of the river, 1882, page 616; the mouth, 1886, page 642, and 1887, page 608.

The commerce consists mainly of coal, iron, building materials, oysters, and raw material for manufacturers, and miscellaneous freight, amounting to about 160,000 tons. The work done and being done has

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enabled vessels to enter the lower river in safety, instead of waiting for high tide in an exposed situation outside the mouth of the river.

The annual value of this commerce is estimated at about nine times the total cost of the projected work.

At the beginning of the fiscal year dredging was in progress, and was continued until August 29, 1896, at which date 28,121 cubic yards had been removed from the outer bar, making the channel 9 feet deep and 100 feet wide, and 6,734 yards from the point of a bar in the bend below Stratford. During the fiscal year contracts were entered into for repairs to the breakwater, and for dredging. The former contract was completed May 22, 1897, 6,652 tons of stone having been placed, leaving the structure in satisfactory condition. The dredging had just been begun at the close of the fiscal year.

A survey called for in the river and harbor act of June 3, 1896, was made, and a report and revised project submitted March 16, 1897. The report is published as House Doc. No. 16, Fifty-fifth Congress, first session, and is also submitted herewith as Appendix D 19.

July 1, 1896, balance unexpended		$32,631.78
June 30, 1897, amount expended during fiscal year		17,713.41
July 1, 1897, balance unexpended		14,918.37
July 1, 1897, outstanding liabilities	$313.40	
July 1, 1897, amount covered by uncompleted contracts	11,439.10	
		11,752.50
July 1, 1897, balance available		3,165.87

Amount (estimated) required for completion of existing project	62,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	35,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix D 9.)

10. Bridgeport Harbor, Connecticut.—[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until August 5, 1896.] This harbor extends nearly 3 miles inland from the north shore of Long Island Sound, its width of about a mile at the mouth decreasing to 200 feet between the opposite wharves at its upper end. The channel in every part of the harbor is comparatively narrow, and is crossed by four drawbridges. Before the first work was done by the United States the depth over the bars near the harbor's mouth was 5 feet at low water, and above the bridges from 2 to 5 feet.

The mean rise of tide is 6½ feet.

In 1836 Congress appropriated $10,000 for improving this harbor, and again the same amount in 1852. These sums were expended in dredging near the mouth of the harbor, making channels 60 to 100 feet wide and 8 feet deep or more at low tide. The depths made did not prove permanent. Under acts of Congress of June 23, 1866, and July 11, 1870, surveys or examinations of the harbor were made, and the report upon the latter examination proposed a plan for improvement by dredging a channel 100 feet wide and 12 feet deep at extreme low water, and protecting the outer channels by a breakwater extending about 3,000 feet from Long Beach, on the east side of the harbor entrance, all at an estimated cost of $124,000. This project was adopted in 1871, when an appropriation was made for beginning work upon it.

In 1875 the dimensions of the proposed channel were modified to make it 12 feet deep at mean low water and from 200 to 300 feet wide up to the lower or Stratford Avenue Bridge. This was accomplished

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in 1882, and then the project was again modified to include widening the channel between the Inner Beacon and the Naugatuck Dock, a distance of 3,800 feet, to prevent overcrowding the main channel by vessels entering for shelter, at an estimated cost of $60,000. This work has been nearly completed.

In compliance with the terms of the river and harbor acts of 1878 and 1888, the project was extended to include a channel 100 feet wide and 9 feet deep to the head of navigation at Berkshire Mills, and again, under the terms of the river and harbor act of 1890, to include a breakwater from The Tongue to the Inner Beacon. The river and harbor act of 1894 also authorized the expenditure of the appropriation made for deepening the channel at the outer bar, and the project was extended to provide for 15 feet depth at that point.

Under the authority of the river and harbor act of 1894 a survey of the harbor was made, and the report, printed in Annual Report, Chief of Engineers for 1896, Part II, pages 803–805, and also in House Doc. No. 61, Fifty-fourth Congress, first session, submitted estimates for extending the 15-foot channel to the lower bridge, making it 300 feet wide up to the Inner Beacon and 200 feet wide above that beacon, which, with the uncompleted work of the then existing project, was estimated to cost $90,000.

The river and harbor act of June 3, 1896, appropriated $28,000 for continuing the improvement in accordance with the modified project, $10,000 of which "shall be expended upon Yellow Mill Pond for constructing a channel 12 feet deep and 200 feet wide from the main channel to the causeway, conditioned upon the construction by the city of Bridgeport of a drawbridge at the causeway upon plans approved by the Secretary of War."

The adopted project is therefore the original project of 1871 thus modified and extended, and consists in making and maintaining a channel from Long Island Sound to the head of navigation at Berkshire Mills, to be 15 feet deep at mean low water and 300 feet wide to the Inner Beacon; thence to the lower bridge to be 15 feet deep and 200 feet wide, with increased width (12 feet deep) for anchorage, and with a 12-foot channel 200 feet wide up to the causeway at the Yellow Mill Pond (the latter estimated to cost $25,000); above the lower bridge to be 9 feet deep and 100 feet wide; the channel and harbor to be protected by a breakwater from the east shore of the harbor's mouth and one from The Tongue to the Inner Beacon, estimated to cost $115,000 in addition to amounts appropriated prior to 1895, or $385,000 from the beginning in 1871.

Harbor lines for this harbor were established by the Secretary of War July 1, 1893.

The last sketch of Bridgeport Harbor in the Annual Report of the Chief of Engineers was printed in the report for 1893, page 940, and a complete map was published in House Doc. No. 61, Fifty-fourth Congress, first session.

The channel, 12 feet deep at mean low water at the entrance, is 200 feet wide for a length of about 1,300 feet; thence to the Inner Beacon, 3,100 feet, the 12-foot channel is about 300 feet wide, and thence to Naugatuck Dock, 3,800 feet, it is 770 feet wide. From that dock to the lower or Stratford Avenue Bridge, 2,000 feet, it has shoaled so that the present depth is from 10 to 11 feet. Within the limits of the 12-foot channel a part of the 15-foot channel has been dredged which extends from the entrance to the Outer Beacon, a distance of one-half mile, and

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is from 60 to 100 feet in width. Above the lower bridge the channel, dredged 9 feet deep and 60 to 100 feet wide, is still nearly of that depth and width. Up to July 1, 1896, $269,818.88 had been expended upon the present project.

No work was done in this harbor during the fiscal year. Under the appropriation of $28,000 in act of June 3, 1896, a contract has been entered into for dredging 140,000 cubic yards. The work is to be completed by December 31, 1897. This work will be widening the 15-foot channel on the east side between the Sound entrance and Outer Beacon to 200 feet, and extending the 15-foot channel from the Outer to the Inner Beacon, with width of from 60 to 100 feet.

The commerce of this harbor consists of coal, iron, building materials, and general merchandise, amounting to about 1,045,000 tons per year. The improvement already made has made it possible to use larger vessels, without which the present commerce of the harbor could not be carried on.

The annual value of this commerce is estimated at about one hundred and fifty times the total cost of the improvement when completed.

July 1, 1896, balance unexpended	$28,181.12
June 30, 1897, amount expended during fiscal year	2,136.17
July 1, 1897, balance unexpended	26,044.95
July 1, 1897, amount covered by uncompleted contracts	14,000.00
July 1, 1897, balance available	12,044.95
Amount (estimated) required for completion of existing project	87,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix D 10.)

11. Saugatuck River and Westport Harbor, Connecticut.—[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until August 5, 1896.] This river is a tidal stream, extending inland about 4½ miles by course of channel from Long Island Sound to Westport, Conn. It has a natural depth of 5 feet at mean low water, in a rather narrow, crooked channel, up to the railroad bridge at Saugatuck, about 3 miles from the Sound; thence the depth decreases gradually until at Westport it is less than 1 foot. The channel is somewhat obstructed by rocks in its upper part.

For nearly 2 miles below Westport the stream is from 200 to 1,200 feet wide; below this it expands into a rather broad inner bay with a narrow channel, following the west, south, and east shores, and then turning abruptly to the southeast and passing to the Sound between Cedar Point on the north and Cockenoes Island on the south. On the south side of the inner bay lies Great Marsh, which is connected with Cockenoes Island by a broad sand flat, nearly bare at low tide, and east of the island a reef of bowlders extends eastward 1½ miles, so that the only entrance to the harbor at low tide is to the eastward of this reef.

The navigable part of the river is crossed by three bridges, all having draws of sufficient size for the commerce of the stream. The uppermost is a wagon bridge at Westport; 1¼ miles below is a wagon bridge near Saugatuck, and a quarter of a mile farther down is the bridge of the New York, New Haven and Hartford Railroad.

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The mean rise of tide is about 7 feet.

Improvements of this locality have been made by the United States under the several titles of Saugatuck Harbor, Cedar Point, Westport Harbor, and Saugatuck River.

In 1826 Congress appropriated $400 for a survey of the river and harbor of Saugatuck. In the report of the survey a project was submitted for deepening the channel near Westport, removing two rocks in the river, building a breakwater on Cedar Point, and cutting a canal through Great Marsh, at a total estimated cost of $6,128.65. The project was completed nearly as designed in 1840. The breakwater at Cedar Point was made about 390 feet long, the top being 4 feet above high water and 10 feet wide, and the canal was excavated 1,350 feet long, 44 feet wide at the bottom, and 4 feet deep, and part of the east side was protected by a dry wall. The amount appropriated for and expended upon this project was $14,044.

Appropriations made in 1867 and 1870, $2,500 each, were applied to surveys and to repairing and extending the breakwater at Cedar Point.

Under the river and harbor act of 1882 a survey of the river was made, but no project for improvement was adopted.

A preliminary examination of Saugatuck River was ordered by the river and harbor act of 1890. A project was adopted under the appropriation made in 1892 for beginning work and it consisted in making a channel 4 feet deep at mean low water and 60 feet wide up to the village of Westport, at an estimated cost of $10,000. This work was completed in 1896.

The river and harbor act of 1894 ordered a survey of Westport Harbor, which was made. The report on this survey is printed in Annual Report of Chief of Engineers for 1896, part 2, page 806; it is also printed with map as House Doc. No. 67, Fifty-fourth Congress, first session. It proposed a further improvement to provide for repairing the Cedar Point breakwater, removing a ledge opposite Stony Point, or dredging around it, and removing bowlders from the channel, at a total estimated cost of $8,000. Under the terms of the river and harbor act of 1896, appropriating $3,000 for improving Westport Harbor, Connecticut, the project of 1892 was extened to include this work, and the estimated cost was in consequence increased to $18,000.

A sketch of this river and harbor was printed in the Annual Report of the Chief of Engineers for 1894, page 670.

At the beginning of the fiscal year the 4-foot channel was completed to Westport, the head of navigation, with width generally of 60 feet, but navigation was rendered difficult by several large bowlders lying near the margin of the dredged channel. The Cedar Point breakwater was in need of repair.

During the fiscal year a contract was entered into and completed for the repairs to the breakwater. A contract for removing the worst bowlders was also made and partly executed.

The commerce consists of coal, manufactured goods, farm produce, and miscellaneous articles, aggregating in 1896 33,500 tons. The improvements made have rendered navigation of the river practicable at less than full high water.

The annual value of this commerce is estimated at about fifty-five times the cost of the present project when completed.

The total amount expended on this improvement up to the close of the fiscal year ending June 30, 1896, has been $29,179.10.

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SAUGATUCK RIVER, CONNECTICUT.

July 1, 1896, balance unexpended	$264.90
June 30, 1897, amount expended during fiscal year	264.90

WESTPORT HARBOR, CONNECTICUT.

July 1, 1896, balance unexpended		$3,000.00
June 30, 1897, amount expended during fiscal year		1,670.70
July 1, 1897, balance unexpended		1,329.30
July 1, 1897, outstanding liabilities	$252.00	
July 1, 1897, amount covered by uncompleted contracts	448.00	
		700.00
July 1, 1897, balance available		629.30

Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix D 11.)

12. Norwalk Harbor, Connecticut.—[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until August 5, 1896.] Norwalk Harbor or River is a tidal estuary, with a narrow channel extending about 3 miles north from Long Island Sound to the town of Norwalk. Above Norwalk the river is a small fresh-water stream. South Norwalk is on the west bank of the river, 1½ miles below Norwalk. At this point the river is crossed by two drawbridges, the lower one a highway bridge and the other (450 feet above) the bridge of the New York, New Haven and Hartford Railroad. The mean tidal range is 7.12 feet.

In 1876 a company was incorporated under the laws of the State of Connecticut for the improvement of the river. Little work was done, and when the improvement was begun by the United States the low-water depth to South Norwalk was 5 feet, and to Norwalk but 1 foot.

By act of March 2, 1829, Congress appropriated $80 "for making a survey of the harbor of Norwalk, Conn., with a view to its improvement." The survey was made and estimates were submitted for making a channel either 10 or 12 feet deep at ordinary high tide, but no money was appropriated for the improvement.

The river and harbor act of 1871 ordered another survey, which was made in that year. The report, printed in Senate Ex. Doc. No. 23, Forty-second Congress, second session, and also in the Annual Report of the Chief of Engineers for 1872, page 900, proposed dredging a channel 6 feet deep and 100 feet wide from Long Island Sound to Norwalk, at an estimated cost of $34,000. This project was adopted under the river and harbor act of 1872. In 1880 the project was modified so as to increase the depth below South Norwalk to 8 feet at mean low water, and the estimate of cost was increased to $84,000, to include this modification and the dredging which had already been done for maintenance of channels. This project was considered completed in 1892.

Under the terms of the river and harbor act of 1894, appropriating $15,000 for continuing this improvement, a project was adopted for dredging and removing the shoal called Ferrys Point, on the west side of the channel, between the railroad docks and Jenning's wharf, making 6 feet depth at mean low water, and, if funds should permit, for widening the bend at Keysers Island, near the harbor entrance, making a depth of 9 feet at mean low water, at a total estimated cost of $15,000.

Up to July 1, 1896, no work had been done under the project of 1894, and the channel had an available depth of 8 feet at mean low water to

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South Norwalk, and of nearly 6 feet to Norwalk, made under the project completed in 1892. A contract for dredging was in force, but work had not been begun.

A survey of Norwalk Harbor, ordered by the river and harbor act of 1894, was made, and the report, printed as House Doc. No. 50, Fifty-fourth Congress, first session, also in Annual Report of the Chief of Engineers for 1896, part 2, page 813, contained estimates for an extension of the improvement to provide for a channel 10 feet deep and 150 feet wide to South Norwalk and for widening two bends at the harbor entrance, at a cost of $62,000. This project was adopted by the river and harbor act of 1896, which appropriated money for beginning work under it, and the project of 1894, thus modified, consists in removing the shoal at Ferrys Point to a depth of 6 feet at mean low water, in making a channel to South Norwalk 150 feet wide and 10 feet deep at mean low water, and in widening the two bends at the harbor entrance, at an estimated cost from the beginning, in 1894, of $77,000.

During the fiscal year the contract of 1894 was begun and completed, as was also another made under the appropriation in act of June 3, 1896. By the first of these Ferrys Point was removed to the probable harbor line, and as a necessary work at Keysers Island had already been done, the small balance was applied to give much-needed relief at Oyster Shell Point immediately below Ferrys Point.

The work under the second contract was applied rather to widening than deepening the channel, although all dredging done was to secure a depth of 10 feet at mean low water. A small sum from this appropriation was applied to the removal of a pile of rock obstructing the channel.

At present a practicable channel 8 feet deep at mean low water extends from Long Island Sound to the railroad bridge at South Norwalk, and a channel 6 feet deep at mean low water from the railroad bridge to the docks at Norwalk.

The maintenance of this channel and of the existing channel above South Norwalk is estimated to cost about $2,000 per year.

A sketch of Norwalk Harbor, Connecticut, was printed in the Annual Report of the Chief of Engineers for 1885, page 656, and a complete map of the narbor was published as House Doc. No. 50, Fifty-fourth Congress, first session.

The amount expended on this improvement to the close of the fiscal year ending June 30, 1896, has been $83,818.51.

The commerce of this harbor consists mainly of coal, lumber, oysters, and miscellaneous freights, amounting to about 200,000 tons. The increased depth resulting from the improvements has been of benefit to all classes of vessels, and to much of the present commerce is absolutely indispensable. The annual value of this commerce is estimated at about sixty times the entire cost of the improvement.

July, 1, 1896, balance unexpended	$24,181.49
June 30, 1897, amount expended during fiscal year	23,625.51
July 1, 1897, balance unexpended	555.98
July 1, 1897, outstanding liabilities	16.95
July 1, 1897, balance available	539.03

Amount (estimated) required for completion of existing project	52,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	25,000.00
Amount required for maintenance in fiscal year ending June 30, 1899	2,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix D 12.)

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13. Five Mile River Harbor, Connecticut.—[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until August 5, 1896.] This harbor is an inlet on the north shore of Long Island Sound, about 2 miles west of the mouth of Norwalk Harbor, Connecticut. It is about 1 mile long and from 300 to 800 feet wide. About three-fourths of a mile above its mouth it runs bare at low tide. At the mouth the natural low-water depth was 3 feet, increasing to 9 feet at a point 750 feet out into the Sound. The mean rise of the tide is about 7 feet.

Since 1848 Five Mile River has been largely engaged in oyster growing, and in this business now employs about 1:0 vessels, which, without the improvement, could only enter or leave the harbor at high tide. Consequently during their busy season they would be obliged to lie up for the night at other and less convenient harbors.

By act of Congress approved August 5, 1886, a survey or examination of this harbor was ordered, which was reported on under date of December 7, 1886 (printed in Annual Report of the Chief of Engineers for 1887, part 1, p. 639).

In this report a project for improvement was proposed, which consisted in dredging a channel 8 feet deep at mean low water and 100 feet wide, to extend up the harbor and to be about 6,000 feet long. The project was adopted in 1888, when work under it was ordered by appropriation of $5,000, made by act of Congress of August 11, 1888.

Up to July 1, 1896, 97,952 cubic yards had been dredged under this project, making the channel about 4,180 feet long, 60 feet wide, and 8 feet deep at mean low water. The total amount expended on this improvement to July 1, 1896, has been $17,127.83.

No work was done during the fiscal year, and the condition of the work remains as above stated. A contract has been entered into under the appropriation in act of June 3, 1896, by which 20,000 yards, more or less, of material will be taken out by December 31, 1897.

Harbor lines were established for this harbor by the Secretary of War January 26, 1892.

A sketch of Five Mile River Harbor was printed in the Annual Report of the Chief of Engineers for 1894, page 676.

The commerce of this harbor consists mainly of coal and shellfish, amounting to about 11,000 tons per year. The increased depth has rendered possible the general use of the harbor by boats engaged in this business.

The annual value of this commerce is estimated at about twenty-five times the money already expended upon this improvement, and about ten times the total cost of projected work.

July 1, 1896, balance unexpended	$2,872.17
June 30, 1897, amount expended during fiscal year	180.01
July 1, 1897, balance unexpended	2,692.16
July 1, 1897, amount covered by uncompleted contracts	1,700.00
July 1, 1897, balance available	992.16
Amount (estimated) required for completion of existing project	25,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix D 13.)

14. Stamford Harbor, Connecticut.—[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until August 5, 1896.] This harbor is on the north shore of Long Island Sound, about 6 miles east

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of the New York State line. It consists of a bay about a mile long and a mile broad, at the head of which two channels extend up nearly a mile toward the middle of the city. The west branch is the mouth of Mill River, a small stream dammed at Oliver Street Bridge, the head of the harbor. The original low-water depth for a mile below the bridge was from 1 to 3 feet in a crooked channel, and the 7-foot curve in the bay was about 7,500 feet below the bridge. All the wharves are in the upper half of this distance. The East Branch was originally a crooked stream running through salt marshes; it was straightened and deepened by private enterprise and was known as the "canal." Though nominally under control of the corporation which deepened it, the East Branch has been for a long time practically, and recently has been formally, opened to public use. In 1892 it had an available depth of 6½ feet at mean low water, with width of about 60 feet nearly to its head, which is about 1½ miles above its junction with the West Branch.

The mean rise of tide is 7.4 feet.

A survey of Stamford Harbor, ordered by act of Congress of March 2, 1829, was made, and with the report estimates were submitted for dredging channels either 10 or 12 feet deep at mean high water. No work was done under this plan.

The river and harbor act of 1882 authorized a survey of the harbor, which was made the following year. The report proposed improvement by dredging a channel through the West Branch 80 feet wide and 5 feet deep at mean low water, at an estimated cost of $20,000. The project was adopted under the river and harbor act of 1886, which made appropriation for beginning the work, and in December, 1891, after $20,000 had been appropriated and expended, the project was reported completed. The channel of the West Branch had been made 5 feet deep to the head of the harbor, with 80 feet width, except in the upper 1,000 feet, where the width was from 50 to 70 feet.

The river and harbor act of 1890 ordered a survey of Stamford Harbor. The report upon the survey presented a plan for further improving the West Branch, at an estimated cost of $95,000. Under the terms of the river and harbor act of 1892, this project was modified to include an improvement of the East Branch, and was adopted as modified. The present approved project, therefore, consists in dredging in the West Branch to make a channel 150 feet wide and 7 feet deep at mean low water, with a basin between the harbor lines at the head of the harbor, and in the East Branch to make a channel 9 feet deep at mean low water, to be 100 feet wide for 8,535 feet, and thence to the head of the harbor, about 1,200 feet, to be 50 feet wide. The estimated cost from the beginning in 1892 is $123,500.

July 1, 1896, the West Branch had a channel depth of 5 feet at mean low water, with width from 50 to 80 feet throughout its length, about 7,000 feet, and a channel 7 feet deep and 115 feet wide for 1,750 feet length at its lower end. The East Branch had a channel 9 feet at mean low water, from 60 to 80 feet wide up to the steamboat dock, about 8,000 feet, and thence for 1,200 feet from 40 to 60 feet wide.

Under the appropriation of $10,000 in act of June 3, 1896, a contract was entered into for dredging in the West Branch. Work was just begun at the close of the fiscal year.

Harbor lines were established in the West Branch by the Secretary of War February 28, 1890.

A sketch of the harbor was printed in the Annual Report of the Chief of Engineers for 1893, page 956.

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The commerce of this harbor consists mainly of coal, building materials, and unclassified freights, amounting to about 220,000 tons. The improvements made have rendered access to the wharves much easier for the class of vessels used in this traffic. The annual value of the commerce is estimated at about sixty-six times the cost of the completed project, and at one hundred and fifty times what has been already expended.

The total amount expended on this improvement up to the close of the fiscal year ending June 30, 1896, has been $44,374.95.

July 1, 1896, balance unexpended		$10,625.05
June 30, 1897, amount expended during fiscal year		1,348.10
July 1, 1897, balance unexpended		9,276.95
July 1, 1897, outstanding liabilities	$668.23	
July 1, 1897, amount covered by uncompleted contracts	6,931.77	
		7,600.00
July 1, 1897, balance available		1,676.95

Amount (estimated) required for completion of existing project	$8,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix D 14.)

15. Harbor at Coscob and Mianus River, Connecticut.—[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until August 5, 1896.] This harbor is a tidal inlet extending about 2 miles northwardly from Long Island Sound at a point 4 miles east of the New York State line. It has a high-water width of from 800 to 2,000 feet, but the low-water channel is narrow and bounded by mud flats. At low tide there was in 1892, before the improvement of the harbor was begun, a natural depth of 7 feet or more, with width of about 200 feet for the first half mile, the depth above gradually decreasing to almost zero at the head of the harbor. The stream is crossed by a drawbridge of the New York, New Haven and Hartford Railroad. The commerce of the harbor is practically confined to the supplies of the communities living along its shores. At Coscob, above the railroad bridge, is a shipyard, where a considerable number of small boats are repaired and some built. At Riverside, below the bridge, are the houses and docks of the Riverside Yacht Club.

The mean rise of tide is about 7½ feet.

Under authority of the river and harbor act of 1890 a survey of the harbor was made. The report on the survey, printed in the Annual Report of the Chief of Engineers for 1891, page 855, contains a plan and estimate for improvement by dredging to make a channel 6 feet deep at mean low water, with 150 feet width below the railroad bridge and 100 feet width above the bridge to Mianus, at an estimated cost of $36,000. This project was adopted under the river and harbor act of 1892, which made an appropriation for beginning work.

By act of August 18, 1894, Congress made appropriation for continuing the improvement "including a survey of the lower part of the harbor with a view of making a turning basin therein." The report upon this survey, printed in the Annual Report of the Chief of Engineers for 1895, page 881, presented plans for a turning basin just inside the harbor entrance, to be 7 feet deep at mean low water and 300 feet wide, to be made by widening the channel on the west side for a length of 2,000 feet measured along the channel and 1,500 feet at the west side of the basin; the estimated cost was $18,000.

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This modification of the project was adopted under the terms of the river and harbor act of 1896, and the present project for this improvement consists in dredging to make a channel 6 feet deep at mean low water, to be 150 feet wide up to the railroad bridge, and thence to Mianus to be 100 feet wide, with a turning basin on the west side of the channel near the harbor entrance 7 feet deep at mean low water, 300 feet wide, and extending 2,000 feet along the channel, at a total estimated cost of $54,000.

Up to July 1, 1896, the channel had been dredged 150 feet wide and 6 feet deep up to the railroad bridge, and of the same depth, 100 feet wide for 1,300 feet above the bridge.

A contract was entered into for the expenditure of the last appropriation, and at the close of the fiscal year work had just begun. This dredging will be in the turning basin, and should do about half of it.

A sketch of Coscob Harbor and Mianus River was printed in the Annual Report of the Chief of Engineers for 1893, page 958, and one of the lower part of this harbor in the report for 1895, page 882.

The commerce of this harbor is mainly coal, lumber, and miscellaneous products, amounting to about 50,000 tons. The benefit to commerce consists only in a broader and deeper channel in the lower part of the harbor, the increased depth being not yet extended to the upper landings.

The annual value of the commerce is estimated at about six times the entire cost of completing the project.

The amount expended on this improvement up to the close of the fiscal year ending June 30, 1896, is $10,579.71.

July 1, 1896, balance unexpended		$8,420.29
June 30, 1897, amount expended during fiscal year		862.70
July 1, 1897, balance unexpended		7,557.59
July 1, 1897, outstanding liabilities	$168.84	
July 1, 1897, amount covered by uncompleted contracts	5,231.16	
		5,400.00
July 1, 1897, balance available		2,157.59
Amount (estimated) required for completion of existing project		35,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix D 15.)

16. Greenwich Harbor, Connecticut.—[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until August 5, 1896.] Greenwich Harbor is a shallow bay about 2 miles east from the New York State line and extending nearly a mile northward from Long Island Sound. The upper part of the harbor runs bare at ordinary low water, and vessels landing at any of the docks, except those in the outer harbor, can enter only at full tide and with draft of not over 6 feet.

The mean rise of tide is about 7½ feet.

The preliminary examination of this harbor was made in compliance with the river and harbor act of 1894, and the report submitted in House Ex. Doc. No. 25, Fifty-third Congress, third session. It is also printed in the Report of Chief of Engineers for 1895, page 860. The improvement recommended was adopted under the river and harbor act of 1896, which appropriated money to begin the work.

During the fiscal year a survey was made and a final project and estimate prepared. A channel 90 feet wide is to be made from the mouth of the harbor to a causeway at its head, a distance of about a

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mile, to be 9 feet deep at mean low water to the lower docks and 6 feet deep above. The upper end is slightly enlarged to form a turning basin. The estimated cost is $20,000.

A contract has been entered into for the expenditure of the appropriation of 1896, under which it is expected to take out 35,000 cubic yards of material from the 6-foot channel in the upper harbor.

The commerce of Greenwich Harbor consists of coal, building materials, stone, and general merchandise, estimated in 1894 to amount to about 110,000 tons per year and valued at $2,835,000. The projected improvement is designed to facilitate the transportation of this freight.

July 1, 1896, balance unexpended	$6,000.00
June 30, 1897, amount expended during fiscal year	610.91
July 1, 1897, balance unexpended	5,389.09
July 1, 1897, amount covered by uncompleted contracts	3,745.00
July 1, 1897, balance available	1,644.09
Amount (estimated) required for completion of existing project	14,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	14,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix D 16.)

SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The surveys of the following localities, required by the act of June 3, 1896, were made by the local engineer, Maj. Smith S. Leach, Corps of Engineers, and reports thereon submitted through the division engineer:

1. Survey of Niantic Harbor, Connecticut.—Major (then Captain) Leach submitted report of survey December 4, 1896. In view of the facts and considerations set forth, he is of the opinion that Niantic Harbor and River are not worthy of improvement by the United States, either with a view to securing increased channel dimensions or constructing a harbor of refuge. The views of the local officer were concurred in by the division engineer, Col. (now Brig. Gen.) John M. Wilson, Corps of Engineers, and by the Chief of Engineers. The report was transmitted to Congress and printed in House Doc. No. 109, Fifty-fourth Congress, second session. (See also Appendix D 17.)

2. Survey of New Haven Harbor, Connecticut.—Major Leach submitted report of survey June 23, 1897. The project of improvement submitted provides for the formation, by dredging, of a channel 20 feet deep at mean low water from Long Island Sound to Tomlinson's bridge, including three interior basins, affording separate anchorages, with depths of 20, 16, and 12 feet, for deep-draft, light-draft, and pleasure vessels, respectively, and connected by adequate channels. From Tomlinson's bridge a channel 200 feet wide and 12 feet deep is projected up Quinnipiac River to Grand avenue, and up Mill River to Chapel street, the Mill River channel to be continued to Grand avenue in two branches, one on each bank, each branch to have a width of 75 feet and depth of 12 feet. The cost of the project is estimated at $400,000. It is the opinion of the local officer that the harbor is worthy of improvement by the General Government on the plans and to the extent set forth in the report, and his views are concurred in by the division engineer, Col. G. L. Gillespie, Corps of Engineers. The report was transmitted to Congress and printed in House Doc. No. 82, Fifty-fifth Congress, first session. (See also Appendix D 18.)

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3. Survey of Housatonic River, Connecticut.—Major Leach submitted report of survey March 16, 1897. This river is now being improved by the United States, and the plan for further improvement presented provides as follows:

a. For a channel 100 feet wide and 7 feet deep at mean low water, to be maintained above Stratford by periodic dredging to 8 feet below mean low water.

b. For a channel 100 feet wide and 7 feet deep at mean low water, to be maintained between Stratford and the bar below by extending the training dike sufficiently to fix the trace of the channel and by periodic dredging to 8 feet.

c. For a channel 200 feet wide and 9 feet deep at mean low water, to be maintained across the outer bar by periodic dredging to 10 feet.

In this connection Major Leach states that a contract for dredging now pending, together with dredging by oystermen on the outer bar, will give the project depth and width throughout the river, and that the following estimate of cost of the work contemplated in the plan of improvement submitted is based on the availability of funds in the amounts and at the periods named, beginning in 1898, viz:

Biennial dredging	$4,000
Training-dike extension	15,000
Appropriation needed for fiscal year ending June 30, 1898	19,000
Appropriation needed for fiscal year ending June 30, 1900, and every alternate year thereafter	4,000

In the opinion of the local officer the Housatonic River is worthy of improvement as above projected and estimated, and this opinion is concurred in by the division engineer, Colonel Gillespie.

The report was transmitted to Congress and printed in House Doc. No. 16, Fifty-fifth Congress, first session. (See also Appendix D 19.)

4. Survey of Southport Harbor, Connecticut.—Major (then Captain) Leach submitted report of survey December 7, 1896. In 1878 a project was adopted for the improvement of this harbor, and provided for dredging a channel 100 feet wide and 4 feet deep at mean low water across the bar and upstream to White Rock; thence two channels of less width to the nearest docks. It is the opinion of the local officer that a channel of the same width as that of the last project, but extended a little farther upstream and 6 feet deep at mean low water, will probably meet all present and reasonable demands. To provide such a channel and repair existing damage to breakwater he estimates will cost, including supervision and administration, $12,700. To maintain the proposed channel depth will cost $300 per annum. The report was transmitted to Congress and printed in House Doc. No. 112, Fifty-fourth Congress, second session. (See also Appendix D 20.)

IMPROVEMENT OF NEW YORK, PEEKSKILL, RONDOUT, AND SAUGERTIES HARBORS, AND OF HUDSON, HARLEM, AND EAST RIVERS, NEW YORK.

This district was in the charge of Col. G. L. Gillespie, Corps of Engineers, to February 23, 1897, and of Lieut. Col. William Ludlow, Corps of Engineers, since that date, with Lieut. Robert McGregor, Corps of Engineers, under their immediate orders.

1. Hudson River, New York.—The improvement of this river was restricted prior to 1892, by the wording of the appropriation acts, to

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that part of it lying between Troy, at the head of navigation, 6 miles above Albany, and New Baltimore, about 14 miles below Albany.

Before the improvement was begun the navigable depth of the channel between New Baltimore and Albany was 7½ feet at mean low water; between Albany and Troy, 4 feet.

The plan of improvement adopted in 1867 proposed making the navigable depth between New Baltimore and Albany 11 feet, and between Albany and Troy 9 feet. This was to be accomplished by the construction of longitudinal dikes to direct the currents, and by dredging.

The estimated cost of making this improvement, prepared in 1882, subject to increase, was $1,078,304. In 1889 the estimated cost was $1,424,435.

The river and harbor act of July 13, 1892, authorized the revised project submitted in 1891, which provided for maintaining old improvements and constructing new regulating works along 8 additional miles of the river below New Baltimore, and also for deepening the entire reach of the river under improvement so as to afford a channel 400 feet wide and 12 feet deep at mean low water from Coxsackie to the foot of Broadway, Troy, N. Y., and thence 300 feet wide and 12 feet deep to the State Dam. The estimated cost of the project is $2,447,906.56.

Under the new project continuing contracts were entered into for the removal of rock and sand covering rock in place, and for dike work and dredging.

The amount expended under the new project to June 30, 1896, was $1,203,504.91. At that date 34,468 linear feet of new dikes and shore revetments had been built, 4,224 linear feet of old dikes had been rebuilt in sections of varying lengths, 10,340 linear feet of old dike had been refilled with rubblestone, and 30,909 square yards of paving had been laid. The channel had been widened and deepened so as to give a depth of 12 feet at mean low water for widths of from 100 to 400 feet between Coxsackie and Patroon Lower Island, above Albany, except at New Baltimore Bar, where an ice gorge had left a bad shoal in the dredged channel; at Coeymans Cross-Over, where as yet no dredging has been done and there was only 11½ feet; at Mulls Cross-Over, where the work of rock removal was still in progress; at a small bar below Nine Mile Tree Cross-Over, through which the depth of the channel was only 11½ feet, and at Castleton Bar and Douws Point Cross-Over, where the dredging had not been completed.

The amount expended during the fiscal year ending June 30, 1897, was $576,438.52, and was applied under contract to the rebuilding of 1,285 linear feet of old dikes; to supplying stone for repairs of old dike and paving; to dredging 1,066,875 cubic yards of material from the channel at Mulls Cross-Over, Castleton and Cedar Hill bars, Bogarts Light Shoal, front of Albany, Bath, Kellogg, Fishhouse and Round shoals, Covills Folly, opposite Breaker Island, Van Buren and Washington bars, opposite Watervliet Arsenal, and opposite foot of Broadway, Troy; to the removal of 57,032.5 tons of rock and 3,587 tons of sand covering rock, at Stone House Bar, North Coeymans, Mulls Cross-Over, opposite Breaker Island, west side of river, Troy, and Congress street, Troy; and to the removal of three wrecks from the navigable channel of the river.

The result of the dredging has been to increase the width and depth of the shoalest portion of Castleton Bar to 250 feet and 11½ feet, respectively, at Douws Point Cross-Over to 200 feet width and 12 feet depth at mean low water. Between the railroad bridges at Albany the 12-foot channel was widened to about 400 feet, thence to the Breaker

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Island Rocks the 12-foot channel is from 200 to 400 feet wide, except at Bath Shoal, opposite the lower end of Patroon Lower Island, where considerable shoaling has occurred, and the depth of only 10½ feet for a width of 170 feet is found since the spring freshets. The channel from Breaker Island Rocks to the lower side of the Erie Canal at Port Schuyler is 12 feet deep at mean low water for a width of from 40 to 120 feet.

The amount of commerce at the section of the river within the limits of the improvements now in progress, for the season of navigation of 1896, amounted to about 5,300,000 tons, and consisted principally of merchandise, lumber, iron ore, salt, grain, brick, hay, and ice, but includes all products of the forest, mines, agriculture, and manufacture, with a total valuation of about $106,400,000.

The work done has benefited commerce by enabling vessels of deeper draft to navigate the river with nearly full loads and towboats of heavy draft to take larger tows without delays from grounding or loss of power by emptying their tanks to reduce draft, to say nothing of freedom from broken wheels and damage to hulls.

The cost of the improvement under the present project is about 2.3 per cent of the value of the commerce benefited during the season of navigation of 1896, which was much under the average.

July 1, 1896, balance unexpended		$608,995.09
Amount appropriated by sundry civil act approved June 4, 1897		475,000.00
		1,083,995.09
June 30, 1897, amount expended during fiscal year		576,438.52
July 1, 1897, balance unexpended		507,556.57
July 1, 1897, outstanding liabilities	$118,610.33	
July 1, 1897, amount covered by uncompleted contracts	350,397.93	
		469,008.26
July 1, 1897, balance available		38,548.31
Amount (estimated) required for completion of existing project		160,406.56
Amount that can be profitably expended in fiscal year ending June 30, 1899		160,406.56
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix E 1.)

2. Saugerties Harbor, New York.—[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, to March 31, 1897.] This harbor is the mouth of the Esopus Creek, which empties into the Hudson River 100 miles above New York City.

The natural depth in the creek was about 7 feet at mean low water, but a broad shoal at the entrance had but about 3 feet available depth, dredged to 7 feet by the State of New York prior to 1887.

A project for improvement was adopted under the appropriation made in 1884 and slightly modified in 1887 before work had been begun. It consisted in securing a channel 8 feet deep at mean low water by constructing parallel dikes and dredging between them, at an estimated cost of $52,000. The project was completed in 1892 at an actual cost of $42,000. Subsequent appropriations have been applied to repairing the dikes and maintaining the channel.

Up to July 1, 1896, $50,634.97 had been expended. The dikes were in fair condition; the north dike was 2,058 feet long and the south dike 2,363½ feet long. The channel between them was 8 feet deep and fully 200 feet wide.

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During the past fiscal year repairs have been made to about 250 feet of the south dike and to about 8 feet of the north dike near the lighthouse, at a cost of $3,523.33.

The available funds are so small that it is not proposed to use them at present, unless in case of emergency, for maintaining the dikes.

The commerce of this harbor consists mainly of bluestone, coal, lumber, pulp wood, and miscellaneous freights, aggregating 120,000 tons, with an estimated money value of $1,800,000. The work done has benefited commerce by enabling the use of vessels of greater draft and allowing entrance at all times of the tide for those trading regularly in the harbor.

The annual value of this commerce is estimated at about one hundred times the entire cost of the improvement.

July 1, 1896, balance unexpended	$3,865.03
June 30, 1897, amount expended during fiscal year	3,523.33
July 1, 1897, balance unexpended	341.70
Amount that can be profitably expended in fiscal year ending June 30, 1899 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	2,500.00

(See Appendix E 2.)

3. Harbor at Rondout, N. Y.—[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, to March 31, 1897.] This harbor is the mouth of Rondout Creek, which empties into the Hudson River on its west shore, 90 miles above New York City, and is the eastern terminus of the Delaware and Hudson Canal. The creek is a tidal stream for 3 miles above its mouth, with mean rise of tide of about 4 feet.

In 1871 the available depth of water in the harbor was 7 feet at mean low water, the result of improvements made by private parties.

In 1872 a project for improvement was adopted under the river and harbor act of that year which provided for securing a permanent channel 14 feet deep at mean low water, by constructing parallel dikes and dredging between them, from the Hudson River channel to deep water in the creek, at an estimated cost of $172,500. The project was completed in 1880, at a total cost of $90,000, and the north dike was reported as 2,200 feet long, the south dike 2,800 feet, a branch dike extending up the Hudson River 1,000 feet, and the channel 13½ feet deep and 50 feet wide, with a 12-foot channel 100 feet wide.

Appropriations since 1880 have been applied to repair of dikes and maintenance of channels.

In 1889, after $101,500 had been expended, the cost of necessary repairs was estimated at $25,000, which would make the cost of the completed project $126,500.

Up to July 1, 1896, $114,172.42 had been expended. The channel, dredged to 14 feet deep at mean low water, had, at the time of the last examination (November 14, 1896), a depth of 14 feet, with a width of at least 40 feet; the 12-foot channel was 90 feet wide and the 10-foot channel 175 feet wide. These results show a material deepening of water since the survey of 1895. The dikes were in need of repair.

The commerce of this harbor consists chiefly of coal, cement, lime, bluestone, ice, and miscellaneous freights. The work done has benefited this commerce by making it possible to use vessels of larger size than formerly.

The annual value of the commerce is estimated at about three hundred times the cost of the completed improvement.

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July 1, 1896, balance unexpended	$4,827.58
June 30, 1897, amount expended during fiscal year	35.72
July 1, 1897, balance unexpended	4,791.86
Amount (estimated) required for completion of existing project	7,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	7,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix E 3.)

4. Harbor at Peekskill, N. Y.—This harbor is a prominent indentation on the eastern shore of the Hudson River at Peekskill, N. Y., about 45 miles above New York City. It has an area of about 1 square mile, approximately, east of the 12-foot curve of the river, and the outlying flats, 3,500 feet wide, have a maximum depth over them of 5 feet at mean low water. A narrow channel 6 feet deep at mean low water follows the shore from north to south past the town wharves. The range of the tides is 2.9 feet.

Under the provisions of the river and harbor act of August 2, 1882, plans and estimates were submitted for a channel 10,000 feet long and 10 feet deep at mean low water, at an estimated cost of $50,000.

Congress made no appropriation on this estimate, but in the river and harbor act of August 11, 1888, provided, in the item for improving Hudson River, for the discretionary application of $10,000 for the improvement of Peekskill Harbor. In view of the pressing necessities of the Hudson River work, none of the money appropriated by the act of 1888 was applied at Peekskill Harbor.

The river and harbor act of August 18, 1894, provided for a further examination, and the report thereon, submitted December 1, 1894, contemplated a channel along the entire wharf front, connecting north and south with the deep-water channel of the Hudson River, at an estimated cost of $50,000.

The river and harbor act of June 3, 1896, appropriated $10,000 for improving this harbor "in accordance with report submitted December 1, 1894."

No work had been done prior to the close of the fiscal year ending June 30, 1896.

The amount expended to June 30, 1897, inclusive of outstanding liabilities, was $9,796.30, and was applied to removing 64,820 cubic yards of material under contract.

A channel 100 feet wide and 9 feet deep, mean low water, has been dredged along the wharf front and connected southward with the deep water of the Hudson River.

The commerce of the harbor for the year 1897 amounted to 546,000 tons, an increase of 23,045 tons since 1894. The estimated cost of the improvement is $50,000, about one-fourth of 1 per cent of the value of the annual commerce.

July 1, 1896, balance unexpended	$10,000.00
June 30, 1897, amount expended during fiscal year	9,796.30
July 1, 1897, balance unexpended	203.70
Amount (estimated) required for completion of existing project	40,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix E 4.)

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5. Harlem River, New York.—The Harlem River and Spuyten Duyvil Creek are both included in this improvement.

Originally there was no navigable waterway between the two streams, as the bed of the connecting reach at Kingsbridge was a long reef of solid rock, bare at low water. The head of navigation at low tide in the Harlem River was practically at High Bridge, 5 miles from its junction with East River at Hell Gate, for vessels of 7 feet draft, and at high tide in Spuyten Duyvil Creek, near Kingsbridge, 1¾ miles from the Hudson, for vessels of 8 feet draft.

The object of the improvement is to form a navigable channel between the East and Hudson rivers.

The project for the improvement, as originally adopted in 1875, was for a channel 350 feet wide and 15 feet deep at mean low water. In 1879 the project was so far modified as to increase the width of the channel in the Harlem River and Spuyten Duyvil Creek to 400 feet, retaining the original width of 350 feet through Dyckman Meadow, but increasing the depth there to 18 feet, mean low water. This project was revised in 1886 by narrowing the channel immediately north of High Bridge, where it skirts the Ogden estate on the east bank, to a least width of 375 feet.

The estimated cost of the work was $2,700,000.

The amount expended upon the improvement up to the close of the fiscal year ending June 30, 1896, was $993,322.96. At that date the rock cut through Dyckman Meadow was completed to the projected width of 350 feet and depth of 18 feet at mean low water; and the new waterway had been excavated eastward and westward from the rock cut so as to afford a navigable channel 12 feet deep, mean low water, and nowhere less than 150 feet wide from the Hudson River to Macomb Dam Bridge at One hundred and fifty-fifth street.

From this point south to Wards Island, East River, the available channel was 15 feet deep and over at mean low water, and nowhere less than 150 feet wide. In the lower Harlem River, Candle Factory Reef had been removed to a depth of 15 feet, mean low water, while the shoal on the opposite side of the river, south of Randall Island Dock, had been further excavated to the same depth, and the remains of the old bridge piers at One hundred and fourteenth street had been removed to a depth of 20 feet, mean low water, thus providing a free channel over 300 feet wide for the deep-draft vessels frequenting this section of the stream, where the available width had originally been but 100 feet.

The amount expended during the fiscal year ending June 30, 1897, was $37,917.70. At that date the new waterway had been widened and deepened so as to afford a navigable channel 12 feet deep, mean low water, nowhere less than 200 feet wide from the Hudson River to the east end of Dyckman Cut, and thence 150 to 180 feet wide to Macomb Dam Bridge at One hundred and fifty-fifth street. From this point south to Wards Island, East River, the available channel is 15 feet deep and over, and nowhere less than 150 feet wide.

The commerce of the river for the year 1895 amounted to 7,533,594 tons, consisting of general merchandise, grain, flour, feed, lumber, building material, fuel, etc., having a total valuation of $203,707,376. The commerce in 1887, when work on the improvement was first begun, amounted to 2,524,155 tons, or less than one-half of the present tonnage. The estimated cost of the improvement is $2,700,000, being about 1 per cent of the value of the present annual commerce.

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July 1, 1896, balance unexpended	$151,677.04
June 30, 1897, amount expended during fiscal year	37,917.70
July 1, 1897, balance unexpended	113,759.34
July 1, 1897, outstanding liabilities	$10,191.45
July 1, 1897, amount covered by uncompleted contracts	66,730.21
	76,921.66
July 1, 1897, balance available	36,837.68

Amount (estimated) required for completion of existing project	1,555,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	500,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix E 5.)

6. East River and Hell Gate, New York.—East River is the designation of the narrow tidal strait which connects New York Harbor with Long Island Sound. It forms a commercial entrance secondary in importance only to the main entrance via Sandy Hook and the Narrows, as the heavy coasting trade carried on by New York and the New England States and the British American Provinces uses it almost exclusively.

The population now bordering New York Harbor numbers 3,000,000 or more, and should the present rate of increase be maintained for half a century longer, the population would be about 8,000,000. The development of the water fronts along the Hudson and East rivers must therefore be certain and rapid, and with this development the importance of the East River entrance will increase greatly. It seems not unreasonable to predict that within the next fifty years the shore line on both sides of the East River within 15 miles of Harlem River and Hell Gate will be occupied by shipping engaged in the local, coasting, and transatlantic trade. The East River is crooked and narrow, much obstructed by rooks and reefs, and traversed by powerful tidal currents. Especially was this the case at Hell Gate, where the channel turns at right angles around Hallets Point, Astoria, and the current runs with a velocity varying at different stages of the tide from 3 to 10 miles an hour over or around Way Reef, Pot Rock, Shell Drake, Frying Pan, Hallets Point, Negro Point, Holmes Rock, Hog Back, Heel Tap, Flood Rock, Hen and Chickens, Gridiron, Mill Rocks, The Negro Heads, Rhinelander Reef, and Bread and Cheese.

Hallets Point projected from the shore at Astoria under water 325 feet to the 26-foot contour, mean low water, and embraced an area of 3 acres.

The detached rocks in the waterway had varying depths over them. The Middle Reef, with an area of about 9 acres, lay in the middle of the channels at Hell Gate.

It had a backbone projecting above high water, called Flood Rock, upon which vessels were frequently stranded at ebb tide when the currents swept directly over the rock. To the northward, near the mouth of the Harlem River, lay the two Mill Rocks, both of which were usually visible at high water. To the eastward, Frying Pan had only 11 feet, mean low water; Heel Tap, 12 feet; Pot Rock, 20 feet, and North Brother Island Reef, 16 feet.

The project of improvement, adopted in 1867, provided for the removal to the depth of 26 feet, mean low water, of the rocks and reefs that lay directly in the channel at Hell Gate and for the construction of sea walls and dikes upon others that lay near the edge of the channel. The estimated cost of the project, revised in 1870, was $4,689,820.

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Besides the obstructions before enumerated, submerged rocks were known to exist at other points in the channel, such as Diamond Reef, 15½ feet, mean low water, off the Battery; Coenties Reef, 14.3 feet, mean low water, off Coenties Slip; Shell Reef, 9 feet, mean low water, between Eighth and Tenth streets; Ferry Reef, 7 feet, mean low water, and Charlotte Rock, 14½ feet, mean low water, opposite Thirty-fourth street; the Middle Ground, 11½ feet, mean low water, off Sunken Meadow, at the entrance to Little Hell Gate, and Mid-Channel Reef, 16½ feet, mean low water, at Baretto Point, opposite Rikers Island.

The project was enlarged in 1874 and the total cost estimated at $5,139,120. (Annual Report Chief of Engineers, 1874, part 2, p. 164.) Besides the improvements already projected at Hell Gate, the new project provided for the construction of a riprap dike to connect the Mill Rocks, sea walls upon Hog Back and Holmes Rock, and the removal to a depth of 26 feet, mean low water, of Diamond Reef, Coenties Reef, and the small rocks known as Scaly Rock, Blackwells Rock, and the rock off Woolsey's bath house.

The project was again enlarged in 1884 to provide for the removal of Pilgrim Rock, opposite Nineteenth street, to 24 feet, mean low water; in 1889, for the removal of reef off Diamond Reef to 26 feet, mean low water; and of Ferry Reef and Charlotte Rock, opposite Thirty-fourth street, to 26 feet, mean low water; in 1890, for the removal of Shell Reef and reef off Sunken Meadow to 18 feet, mean low water; and in 1892 for the removal of Baretto Reef to 24 feet, mean low water.

The amount expended up to the close of the fiscal year ending June 30, 1896, was $4,317,991.60. At that date Hallets Point, covering 3 acres, Way Reef, Shell Drake, Diamond Reef, North Brother Island Reef, Coenties Reef, reef off Diamond Reef, Baretto Reef, and Scaly Rock had been removed to the depth contemplated in the project. Pilgrim Rock and Ferry Reef, off Thirty-fourth street, had been reduced to a least depth of 24 feet; Heel Tap had been broken to 26 feet and dredged to 20.5 feet, and the least depth on Frying Pan and Pot Rock was 18 feet and 22.8 feet at mean low water, respectively. Flood Rock and connecting reefs, covering 9 acres, had been broken to 30 feet and 204,015 tons of débris had been removed. The least depth over Flood Rock, Hen and Chickens, and Gridiron was 20 feet at mean low water, and that in the channel between Flood Rock and the Mill Rocks was 18 feet, mean low water. Shell Reef, off Ninth street, had been reduced to 18 feet, mean low water, except at a few points. The reef off Sunken Meadow, which originally had only 11 feet over it, had been lowered to 16 feet, mean low water, over the main reefs, and to 18 feet, mean low water, on the southern half. A sea wall had been built by the Government to connect Great and Little Mill Rocks, and another by the city authorities on Bread and Cheese. These results have been of the greatest value to navigation.

The amount expended during the fiscal year ending June 30, 1897, was $53,331.59, and was applied in removing, by hired labor and use of Government plant, 2,171 tons of broken stone from reef off Sunken Meadow and 7,485 tons of broken stone from Charlotte Rock. The reef off Sunken Meadow has been lowered to 18 feet mean low water, and Charlotte Rock has been entirely removed to 26 feet mean low water. The plant was laid up on June 23.

It is impracticable to collect statistics showing the value of the commerce passing through Hell Gate, which consists mainly of the heavy coastwise traffic between New York and the New England States, and is carried in vessels that do not enter or clear at the custom-house.

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July 1, 1896, balance unexpended	$67,287.73
June 30, 1897, amount expended during fiscal year	53,331.59
July 1, 1897, balance unexpended	13,956.14
July 1, 1897, outstanding liabilities	3,523.97
July 1, 1897, balance available	10,432.17

Amount (estimated) required for completion of existing project	753,840.67
Amount that can be profitably expended in fiscal year ending June 30, 1899	200,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix E 6.)

7. *New York Harbor, New York.*—Before the improvement of the main entrance into New York Harbor was undertaken by the United States the least depth in mid-channel on the outer bar was 23.7 feet at mean low water, and about the same across three other shoals between the bar and deep water in the harbor.

A large proportion of the commerce of the port, carried in vessels of great draft, could cross these shoals only at or near high water.

The project for the improvement of Gedney Channel was approved by the Secretary of War December, 1884, and extended to cover the whole of the main entrance to the harbor December, 1886. It provided for dredging a channel 1,000 feet wide and 30 feet deep at mean low water from deep water below the Narrows through the main ship and Gedney channels to deep water outside the bar.

The estimated cost was $1,490,000, for dredging 4,300,000 cubic yards. The actual amount dredged to October, 1891, when the work was approximately completed, was 4,875,079 cubic yards.

The total amount expended to June 30, 1896, was $1,702,386.18.

In work of this character, where sandy, gravelly, and muddy beds are exposed to wave and tidal current action, there is an inevitable tendency toward deterioration in the capacity of excavated channels, and particularly is this the case where the depths secured are greater than the natural conditions permit.

The question, then, resolves itself into one of cost of maintenance in connection with that of enlargement to meet increased requirements in the matter of draft and adequate width of fairway.

A resurvey of the shoals and entrance channels is in progress for the procurement of data upon which to base revised estimates of cost.

The riprap sea wall authorized by the Chief of Engineers February 20, 1890, for the protection of the north shore of Sandy Hook, was built from Jetty No. 1 westward to a point 119 feet westward of Jetty No. 11, a total distance of 2,575 feet. Under authority granted June 6, 1894, 280 feet of wall was constructed for the protection of the beach in front of the pneumatic-gun battery.

The amount expended during the fiscal year ending June 30, 1897, was $38,060.06, and was applied in operating the U. S. steamer *Gedney* by hired labor in removing 79,369 cubic yards of material from Gedney and main ship channels.

The last appropriation for completion of the approved project was made by act of September 19, 1890. The subsequent appropriations were for purchase of plant and maintenance of improvement.

The total amount expended to June 30, 1897, is necessarily in excess of the estimated cost of the project, which was completed in October, 1891.

The foreign exports and imports for the port of New York during the

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fiscal year ending June 30, 1896, were valued at $1,039,364,216. The increase of the value of foreign commerce over that of 1886, before improvement was begun, is $236,829,202. The cost of the improvement to date is $1,740,446.24, or about three-fourths of 1 per cent of the increase in foreign commerce and less than one-fourth of 1 per cent of the value of foreign commerce of 1896.

July 1, 1896, balance unexpended		$111,038.34
June 30, 1897, amount expended during fiscal year		38,060.06
July 1, 1897, balance unexpended		72,978.28
July 1, 1897, outstanding liabilities	$4,249.79	
July 1, 1897, amount covered by uncompleted contracts	12,270.00	
		16,519.79
July 1, 1897, balance available		56,458.49
Amount that can be profitably expended in fiscal year ending June 30, 1899 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		500,000.00

(See Appendix E 7.)

8. Removing sunken vessels or craft obstructing or endangering navigation.—The barge *Andrew Jackson*, loaded with 1,500 tons of coal, was sunk in Gedney Channel, New York entrance, on May 22, 1896. After advertisement, an agreement was made for the removal of the wreck and cargo; the work was completed August 14, 1896, at a cost of $8,880.71.

The ferryboat *New Brunswick*, while on fire, sunk about February 1, 1897, south of the Port Liberty Wharf, Jersey City, N. J. The wreck was removed March 12, under agreement, at a cost of $895.

The British steamship *Ailsa* sunk in New York Harbor, after collision, on February 29, 1896, on the east side of the Narrows below Fort Hamilton. After advertisement, a contract was made for the removal of the wreck, to a depth of 40 feet at low water, at a cost of $11,975. Work was in progress on the removal at the close of the fiscal year.

The British steamer *Alvena* sunk in New York Harbor, after collision, on January 19, 1897, 1,500 feet southeast of Buoy B 1. After advertisement, a contract was made for the removal of the wreck and cargo, at a cost of $36,000. No work was done prior to the close of the fiscal year.

The wreck of the canal boat *Hager Johnson* was removed from the west side of the Hudson River below Edgewater June 5, 1897, under agreement, at a cost of $75.

The total amount expended during the year on the removal of wrecks was $9,775.71.

(See Appendix E 8.)

EXAMINATIONS AND SURVEY MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The preliminary examinations and survey of the following localities, required by the act of June 3, 1896, were made by the local officer, Col. G. L. Gillespie, Corps of Engineers, and reports thereon submitted:

1. Preliminary examination of Catskill Creek, New York.—Colonel Gillespie submitted report of examination October 26, 1896. It is his opinion that this creek is worthy of improvement by the General Government to the extent of providing a channel 200 feet wide and 10 feet deep at mean low water from the entrance to the railroad bridge, a

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distance of 1½ miles. The Chief of Engineers concurred in this opinion to the extent of advising a survey of the creek, estimated to cost $350, upon the results of which a more reliable opinion as to the extent of the improvement justified by the commerce involved could be formed. The report was transmitted to Congress and printed in House Doc. No. 56, Fifty-fourth Congress, second session. (See also Appendix E 9.)

2. Preliminary examination of Nyack Harbor, New York.—Colonel Gillespie submitted report of examination October 26, 1896. In his judgment this harbor is worthy of improvement by the General Government to the extent of opening by dredging a channel, from the town docks eastward, 200 feet wide and 12 feet deep at mean low water, to connect with the channel of the river. The Chief of Engineers concurred with the local officer in so far as to advise a survey of the harbor, estimated to cost $400, upon the results of which a more reliable opinion as to the extent of the improvement justified by the commerce involved could be formed. The report was transmitted to Congress and printed in House Doc. No. 58, Fifty-fourth Congress, second session. (See also Appendix E 10.)

3. Preliminary examination of Wallabout Channel, New York.—Colonel Gillespie submitted report of examination September 23, 1896. It is his opinion that Wallabout Channel is worthy of improvement by the General Government to the extent of increasing the depth of the eastern channel to 20 feet at mean low water from the entrance to the timber causeway uniting the center of the island with the United States navy-yard, Brooklyn, N. Y. The Chief of Engineers concurred in the views of the local officer in so far as to advise the making of a survey, estimated to cost $250, upon the results of which a more reliable opinion could be formed as to the scope of the improvement justified by the interests involved. The report was transmitted to Congress and printed in House Doc. No. 122, Fifty-fourth Congress, second session. (See also Appendix E 11.)

4. Preliminary examination of Coney Island Channel, New York, from Norton Point to the bell buoy.—Colonel Gillespie submitted report of examination September 23, 1896. It is the opinion of the local officer that Coney Island Channel is worthy of improvement by the General Government to the extent of increasing the depth to 16 feet at mean low water, and the Chief of Engineers concurred in this view in so far as to advise the making of a survey of the channel, estimated to cost $250, upon the results of which a more reliable opinion could be formed as to the extent of the improvement justified by the commerce involved. The report was transmitted to Congress and printed in House Doc. No. 59, Fifty-fourth Congress, second session. (See also Appendix E 12.)

5. Preliminary examination of Coney Island Creek, New York.—Colonel Gillespie submitted report of examination October 26, 1896. It is his opinion, concurred in by the Chief of Engineers, that this creek is not worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 111, Fifty-fourth Congress, second session. (See also Appendix E 13.)

6. Survey of New York Harbor, New York, from the Narrows to the sea, with a view of obtaining a depth of 35 feet at mean low-water mark.—Colonel Gillespie submitted report of survey January 26, 1897. He estimates that to obtain a channel 1,000 feet wide and 35 feet deep at mean low water would cost $1,740,000. This amount includes the cost of constructing four dredges at $100,000 each. A channel of similar depth and 1,500 feet wide is estimated to cost $2,772,000, which amount includes the cost of constructing five dredges at $100,000 each. The

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estimated cost of obtaining a channel of same depth and 2,000 feet wide is $4,180,000, which includes the cost of six dredges at $100,000 each. These estimates are based upon the net cost of dredging heretofore done in the harbor by the United States dredge. Should the work be done by contract the estimated cost should be increased 20 per cent, and would be as follows for a depth of 35 feet:

Channel 1,000 feet wide	$2,088,000
Channel 1,500 feet wide	3,326,400
Channel 2,000 feet wide	5,016,000

Colonel Gillespie considers the improvement providing for a channel 1,000 feet wide and 35 feet deep at mean low water from the Narrows to the sea to be a worthy one and justified by the interests of commerce involved. The report was transmitted to Congress and printed in House Doc. No. 243, Fifty-fourth Congress, second session. (See also Appendix E 14.)

IMPROVEMENT OF BAY RIDGE, RED HOOK, AND BUTTERMILK CHANNELS, NEW YORK HARBOR; OF RIVERS AND HARBORS IN NEW YORK ON LONG ISLAND SOUND, ON SOUTHERN SHORE OF LONG ISLAND, AND IN NORTHEASTERN NEW JERSEY.

This district was in the charge of Maj. H. M. Adams, Corps of Engineers, having under his immediate orders Lieut. Robert R. Raymond, Corps of Engineers, since July 18, 1896; Division Engineers, Col. (now Brig. Gen.) John M. Wilson, Corps of Engineers, to February 11, 1897, and Col. G. L. Gillespie, Corps of Engineers, since that date.

1. Port Chester Harbor, New York.—This harbor, at the boundary between the States of New York and Connecticut, consists of a bay opening into Long Island Sound at the mouth of Byram River and of the lower part of the river itself, which is navigable for about a mile above its mouth.

The original available depth in the river was not more than a foot at low water, and Salt Rock in the river and Sunken Rock in the bay were considered dangerous obstructions.

The project for improvement, adopted in 1871, provided for the removal of these rocks to 9 and 11 feet depth, respectively, and for the construction of a breakwater at Byram Point, at the mouth of the harbor, the estimated cost being $96,632.

In 1884 the project was extended to provide for dredging a channel 2½ feet deep, and from 60 to 100 feet wide, from the bay to the vicinity of the village wharves. In 1888 the project was further modified to omit the removal of Sunken Rock and to build a breakwater from that rock to Byram Point, which should also serve as a beacon on the rock. A revised estimate of cost, made in 1890 in accordance with these modifications, reduced the cost of completion by about $40,000, making the total estimated cost $57,000.

Up to July 1, 1896, $46,875.41 had been expended, Salt Rock had been removed to 9 feet depth, the breakwater from Sunken Rock to Byram Point had been completed, a channel 8 feet deep at mean low water had been dredged 75 feet wide up to Town Dock, and above that dock the depth to the Port Chester landings had been made 2½ feet.

During the past fiscal year the channel from Town Dock to the steamboat landing at Port Chester was dredged 6 feet deep at mean low water and 60 feet wide, this width being increased to 100 feet at the bend just below the steamboat landing.

The results of the work have been to admit vessels of greater draft than formerly and to provide them with shelter while waiting for high tide to go to the landings.

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Future appropriations will be applied to maintaining and extending the dredged channels.

The commerce of this harber consists of coal, iron, building materials, farm produce, and miscellaneous freights, amounting to about 114,749 tons per year. The annual value of this commerce is estimated at about nineteen times the entire cost of completing the project.

The following table shows the tonnage of commerce reported for this harbor for several years since 1885:

	Tons.
1885	81,000
1890	160,000
1893	163,000
1895	73,257

No new lines of transportation have been reported as established since July 1, 1896.

July 1, 1896, balance unexpended	$5,124.59
June 30, 1897, amount expended during fiscal year	4,938.04
July 1, 1897, balance unexpended	186.55
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix F 1.)

2. *Mamaroneck Harbor, New York.*—This harbor consists of a narrow inlet opening into a broad bay, with several dangerous rocks in or near the channel at head of the bay. The low-water depth to the old steamboat wharf halfway up the inlet was 5 feet; thence to the upper wharves it was about 1 foot.

A project for improvement, adopted in 1882, provided for removing one rock to 4 feet depth, five rocks to 7 feet depth, and for making a channel 100 feet wide and 7 feet deep at mean low water up to the old steamboat wharf, and thence to the upper wharves 80 feet wide and 4 feet deep, at an estimated cost of $43,000.

Up to July 1, 1896, $15,000 had been expended in removing one rock to 4 feet depth and two to 7 feet depth at mean low water.

During the past fiscal year a channel 60 feet wide and 6 feet deep at mean low water was dredged from 6 feet depth in the bay up to the upper wharves, a total length of 3,550 feet.

The commerce of Mamaroneck Harbor is principally coal, building materials, farm produce, and general merchandise, amounting in 1896 to about 29,095 tons per year. In 1888 this commerce was reported as 24,986 tons. The improvement has resulted in making the upper wharves accessible to vessels of 4 feet greater draft than formerly and in making the navigation of the harbor safer and easier.

The annual value of the commerce is estimated at eleven times the entire cost of the improvement when completed.

No new lines of transportation have been established during the past fiscal year.

July 1, 1896, balance unexpended	$10,000.00
June 30, 1897, amount expended during fiscal year	9,939.46
July 1, 1897, balance unexpended	60.54
Amount (estimated) required for completion of existing project	18,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix F 2.)

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3. East Chester Creek, New York.—This is a small tidal stream emptying into Pelham Bay, at the west end of the north shore of Long Island Sound. Before improvement it was navigable at high tide for vessels drawing 7 feet only up to Lockwoods, a distance of 2¼ miles. The rise of tide is 7.1 feet.

The original project for improvement, adopted in 1873, provided for making a channel 100 feet wide and 9 feet deep at mean high water (about 2 feet at low water) from deep water in Pelham Bay to a point 3,000 feet above Lockwoods, at an estimated cost of $136,500, subsequently reduced to $124,000.

Up to July 1, 1896, $80,547.01 had been expended upon this improvement. The channel had been made the full depth and width up to a point 3,000 feet above Lockwoods; below Lockwoods, for a distance of half a mile, the depth had shoaled and the channel narrowed.

During the past fiscal year a contract for dredging and rock excavation below Lockwoods has been entered into, but work has not yet been begun.

The available funds will be applied to widening and deepening the channel between Town Dock and Lockwoods and, if sufficient balance remains, to extending the channel beyond the point 3,000 feet above Lockwoods, as authorized by act of Congress approved February 17, 1897.

No additional appropriation is needed for completion of the project of 1873; dredging will probably be needed from time to time to maintain the channel.

The commerce of East Chester Creek consists of coal, building materials, stone, and miscellaneous freight, amounting to about 95,000 tons per year.

The following table shows the variations in amount of commerce reported for several years since the first report, in 1887:

	Tons.		Tons.
1887	16,110	1893	55,990
1890	19,505	1894	137,268
1892	47,115	1895	94,928

The value of this commerce in 1896 is estimated at about 18 times the entire cost of the completed improvement.

No new lines of transportation have been established during the past fiscal year.

July 1, 1896, balance unexpended		$10,452.99
June 30, 1897, amount expended during fiscal year		68.25
July 1, 1897, balance unexpended		10,384.74
July 1, 1897, outstanding liabilities	$25.00	
July 1, 1897, amount covered by uncompleted contracts	9,000.00	
		9,025.00
July 1, 1897, balance available		1,359.74

(See Appendix F 3.)

4. Bronx River, New York.—The navigable part of this stream is the tidal part, extending about 3 miles from its mouth, and lying wholly within the limits of the city of New York. It has naturally a depth of 4 feet at the entrance, decreasing to less than 1 foot at the head of navigation, where the rise of tide is about 6 feet.

The project for improvement was adopted in compliance with the

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river and harbor act of 1896, and contemplates dredging and rock removal to make a channel 4 feet deep at mean low water, to be 100 feet wide at and near the mouth, decreasing to 50 feet at the head of navigation. The estimated cost is $85,985.

Up to July 1, 1896, no work had been done upon this project and no money expended.

During the past fiscal year 1,126.37 cubic yards of rock has been removed from the lower part of the stream, making a depth of 6 feet at mean low water, and materially improving the navigation of the river over a length of about half a mile at a point 1½ miles above its mouth. The work was done under a contract which is nearly completed.

Future appropriations should be applied to the rock removal and dredging proposed under the adopted project.

The commerce of the Bronx River consists principally of coal, building materials, stone, and miscellaneous freights, amounting in 1896 to 94,244 tons. The estimated value of this freight ($454,403) is about five times the estimated cost of the projected improvement.

The only prior record of commerce is that reported in 1890, as about 220,000 tons per year.

No new lines of transportation have been established during the past fiscal year.

July 1, 1896, balance unexpended		$10,000.00
June 30, 1897, amount expended during fiscal year		2,498.91
July 1, 1897, balance unexpended		7,501.09
July 1, 1897, outstanding liabilities	$6,648.89	
July 1, 1897, amount covered by uncompleted contracts	851.81	
		7,500.70
July 1, 1897, balance available		.39
Amount (estimated) required for completion of existing project		75,985.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix F 4.)

5. Mattituck Harbor, New York.—This harbor is a tidal inlet extending about 2 miles south from Long Island Sound to the village of Mattituck, on Long Island, about 70 miles east from New York City. The natural depth at the entrance is from 1 to 2 feet at low tide; inside the entrance the depth is rather greater to the tide mill, about a mile from its mouth; above the tide mill slack high water is maintained, with depth of about 6 feet to Mattituck. The rise of tide outside the harbor's mouth is 4.8 feet, and below the tide mill but 2.2 feet.

The project for improvement, adopted under the terms of the river and harbor act of June 3, 1896, contemplates making a channel of 7 feet depth at mean low water, to be 100 feet wide at the entrance, and thence to the tide mill to be 80 feet wide, and extending the same to the village of Mattituck with depth of 7 feet at high water and 80 feet width, the entrance channel to be protected by parallel jetties. The estimated cost of this work is $83,000.

No work has been done under this project and no money expended.

In carrying out the project for improvement the first work done should be the construction of the jetties at the entrance, estimated to cost about $40,000. The available funds are sufficient to build only one-half of one of the jetties, which would be of no benefit to naviga-

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tion. Therefore, it is proposed to defer the beginning of work until sufficient funds are provided to build one or both jetties, which could be done in one working season.

The commerce of Mattituck Harbor consists of farm produce and fertilizers, amounting in 1890 to about 3,000 tons, valued at $33,470. The greater part of the local freight was received and shipped by rail.

July 1, 1896, balance unexpended	$10,000.00
July 1, 1897, balance unexpended	10,000.00
Amount (estimated) required for completion of existing project	73,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix F 5.)

6. Port Jefferson Harbor, New York.—This harbor is a large and deep inland bay with a narrow entrance or inlet, outside of which was originally a shoal with 4 feet depth at low water. The location of the inlet is one of the most exposed on Long Island Sound.

The first project for improvement was adopted in 1871 and completed in 1883 at a total cost of $79,000. Two jetties were built to shelter the inlet channel, one east of the inlet, 1,390 feet long, and one west, 940 feet, both to scant cross section. A channel 8 feet deep at mean low water and 100 feet wide was dredged through the inlet and the shoal outside.

An examination of Port Jefferson Inlet was made under the river and harbor act of 1888, and under the act of 1890 a project for improvement was adopted providing for a depth of 10 feet at mean low water. This was modified in compliance with the terms of the river and harbor act of 1894, to make a depth of 12 feet, and the present project for improvement therefore provides for a channel through the harbor entrance 12 feet deep at mean low water and 200 feet wide, to be made by dredging and to be protected by extending and enlarging the previously built breakwaters, at an estimated cost of $145,000.

Up to July 1, 1896, $41,702.76 had been expended upon the present project; both jetties had been partly enlarged, a channel 10 feet deep at mean low water and over 200 feet wide had been dredged through the entrance bar, and 100 feet width of this channel had been further deepened to 12 feet.

During the past fiscal year the 12-foot channel has been widened to 160 and 180 feet.

Future appropriations will be applied to enlarging and extending the jetties and to maintaining the 12-foot channel.

The commerce of this harbor consists of coal, building materials, farm produce, shellfish, and general merchandise, amounting in 1896 to 31,700 tons. The harbor is also largely used as a winter anchorage for yachts. The result of the improvement has been to render access to the harbor comparatively easy and safe.

The annual value of the commerce of the harbor, exclusive of shipbuilding and repairing, is estimated at about six times the total cost of the present project.

The following table shows the recent variations in the commerce reported:

	Tons.		Tons.
1890	42,325	1894	42,000
1892	47,000	1895	36,000
1893	46,000		

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No new lines of transportation have been reported as established since July 1, 1896.

July 1, 1896, balance unexpended		$8,297.24
June 30, 1897, amount expended during fiscal year		2,275.58
July 1, 1897, balance unexpended		6,021.66
July 1, 1897, outstanding liabilities	$4,735.46	
July 1, 1897, amount covered by uncompleted contracts	287.69	
		5,023.15
July 1, 1897, balance available		998.51
Amount (estimated) required for completion of existing project		95,000.00
Amount that can be profitably expended in fiscal ending year June 30, 1899		25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix F 6.)

7. *Huntington Harbor, New York.*—This is a tidal inlet extending southward from Huntington Bay to the village of Huntington. It is about 2 miles long, quite narrow, and landlocked, and has a natural available depth of nearly 8 feet at mean low water up to within three-fourths of a mile of the head of the harbor, where the low-water depth shoaled gradually to zero.

In 1872-73 a channel 8 feet deep and 150 feet wide was dredged in the upper part of the harbor by the United States at a cost of $22.500. Within ten years following this had nearly filled up.

In 1884 a survey was ordered by Congress, and under authority of the river and harbor act of 1890 a project for improvement was adopted, providing for redredging a channel 8 feet deep and 100 feet wide up to the upper wharves, at an estimated cost of $32,000. The estimate also includes a pile protection for part of the channel, but it seems probable that equally good results can be obtained by applying the funds to dredging a greater width.

Up to July 1, 1896, $16,848.26 had been expended under the present project in dredging a channel 8 feet deep at mean low water, 125 feet wide up to the bend at old town dock, 185 feet wide at the bend, and 90 feet wide for 500 feet above the bend, a total length of 3,500 feet.

During the past fiscal year shoals have been removed from the previously dredged channel and the channel has been widened by 40 feet, making it from 100 to 175 feet wide with greater width at the bend.

Future appropriations will be applied to such dredging as is necessary for completing and maintaining the channel.

The commerce consists mainly in coal, building materials, and miscellaneous freights, amounting to about 73,350 tons in 1896. Vessels which formerly waited for high tide to reach the landings now reach them at any ordinary stage of water.

The present annual value of this commerce is estimated at about thirty-seven times the entire cost of the present project when completed.

The following table shows the variations in reported tonnage of commerce for several years since 1890:

	Tons.		Tons.
1890	39,500	1894	58,000
1892	44,000	1895	70,000
1893	46,000		

No new lines of transportation are reported as established during the past fiscal year.

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July 1, 1896, balance unexpended	$5,151.74
June 30, 1897, amount expended during fiscal year	4,831.97
July 1, 1897, balance unexpended	319.77
July 1, 1897, outstanding liabilities	95.83
July 1, 1897, balance available	223.94
Amount (estimated) required for completion of existing project	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix F 7.)

8. Glencove Harbor, New York.—This harbor is an inlet on the east side of Hempstead Harbor, which is accessible only at high tide, and a breakwater was needed to shelter vessels while at anchor waiting for tides.

The project for improvement, adopted in 1888, provided for a riprap breakwater about 2,500 feet long, extending in a west-southwesterly direction from the northwest corner of the Glencove Dock, the top to be 5 feet wide and 3 feet above mean high water, and slopes to be 1 on 1. Its estimated cost was $201,960. In 1895 the project was modified to limit the length of the breakwater to about 2,000 feet, and revised estimates were made, based upon the cost of work already done, and reducing the estimate of cost, from the beginning of work in 1888, to $135,000.

Up to July 1, 1896, $54,500.10 had been expended in building 1,289 linear feet of breakwater, affording a limited shelter, which enabled vessels to use the Glencove landing in all weather or to lie securely at anchor until rise of tide made the inner harbor of Glencove navigable.

During the past fiscal year the breakwater has been repaired and extended 176 feet, making its total length 1,465 feet.

The commerce of Glencove Harbor consists chiefly of coal, corn, starch, glucose, and miscellaneous freights, amounting in 1896 to 106,435 tons. The annual value of these freights is estimated at about twelve times the cost of the completed improvement.

The result of the improvement has been to afford a shelter where vessels carrying these cargoes can lie.

Following is a statement of the amounts of commerce for the several years since 1889, as far as presented:

	Tons.
1889	301,429
1893	305,000
1896	106,435

July 1, 1896, balance unexpended	$8,499.90
June 30, 1897, amount expended during fiscal year	7,929.64
July 1, 1897, balance unexpended	570.26
July 1, 1897, outstanding liabilities	16.00
July 1, 1897, balance available	554.26
Amount (estimated) required for completion of existing project	72,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix F 8.)

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9. Flushing Bay, New York.—Before improvement the available depth in this broad, shallow bay and in the channel leading up to Flushing was less than 4 feet at mean low water.

The project for improvement, adopted in 1879, contemplated building 16,700 feet of diking to form a tidal basin which, by filling and discharging through the main channel, would maintain a channel depth of 6 feet or more at mean low water, after once dredging. The bottom is soft mud. The estimated cost of this work was $173,500.

In 1888 the project was modified to omit part of the diking, which then appeared unnecessary, and in 1891, at the request of many citizens, the extension of dikes was wholly omitted from the project.

Up to July 1, 1896, $118,522.68 had been expended, 4,663 linear feet of diking had been built, and the channel of 100 feet width and 6 feet depth at mean low water had been dredged, in places several times. In parts of the harbor it was still shoal.

During the past fiscal year 20,494 cubic yards of material was dredged, making channels through these shoals at and below the north end of the dike and through one shoal just below the bridge at the head of the harbor.

Future appropriations should be applied mainly to such dredging as may be needed to free the channel from shoals.

The improvement of Flushing Bay has resulted in making the water front accessible to many of the vessels even at low tide and in permitting the use of vessels of increased draft at high tide.

The commerce of Flushing Bay consists chiefly of coal, building materials, dyewoods, manufactured products, and miscellaneous freights, amounting in 1896 to 80,820 tons, valued at $1,598,155. The value of this commerce is about nine times the cost of the improvement.

Following is a statement of the amounts of commerce reported for Flushing Bay during the several years since 1888:

	Tons.
1888	229,235
1894 (partial returns)	46,942
1895	150,376

July 1, 1896, balance unexpended	$4,477.32
June 30, 1897, amount expended during fiscal year	3,852.08
July 1, 1897, balance unexpended	625.24
Amount (estimated) required for completion of existing project	50,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix F 9.)

10. Patchogue River, New York.—This is a shallow tidal inlet extending about a mile northward from the shore of Great South Bay, Long Island, to the village of Patchogue. The natural depth in the stream and over a bar at the mouth was from 2 to 3 feet at mean low water, and the rise of tide is about 1 foot.

In 1880 and in 1886 examinations were made by order of Congress, and in 1890 a project was adopted for making a channel 6 feet deep at mean low water and 60 feet wide from Great South Bay to the village wharves, about 5,000 feet, and for protecting the entrance channel by a jetty 1,700 feet long on the west side, at an estimated cost of $40,000.

Up to July 1, 1896, $25,570.18 had been expended. A jetty 1,340 feet long had been built on the west side of the harbor entrance, and a channel 6 feet deep at mean low water and 60 feet wide had been

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dredged from deep water in Great South Bay to a point 2,200 feet up from the mouth of the river.

During the past fiscal year the jetty has been completed by extending it 360 feet, making it 1,700 feet long, and by repairing parts of it which had settled; the dredged channel has also been extended to within 80 feet of the head of the harbor, widening it to 100 feet at the upper end as a turning basin for vessels.

With the remainder of available funds shoals will be removed from the dredged channel and the project will be completed.

The commerce of Patchogue River consists mainly of lumber, coal, fish, and shellfish, amounting in 1896 to 143,500 tons, valued at $3,262,000. This value is over eighty times the cost of the improvement.

The improvement has enabled vessels of 6 feet draft to reach the channel opposite the docks at ordinary tides without lightering.

Following is a statement of the amounts of commerce of Patchogue River reported for several years since 1890:

	Tons.		Tons.
1890	56,000	1894	145,000
1892	120,000	1895	129,485
1893	125,000		

July 1, 1896, balance unexpended		$14,429.82
June 30, 1897, amount expended during fiscal year		8,471.35
July 1, 1897, balance unexpended		5,958.47
July 1, 1897, outstanding liabilities	$1,963.49	
July 1, 1897, amount covered by uncompleted contracts	3,427.46	
		5,390.95
July 1, 1897, balance available		567.52

(See Appendix F 10.)

11. Browns Creek, Sayville, N. Y.—This is a narrow stream extending northward from Great South Bay to the Sayville Highway Bridge, above which it is wholly a fresh-water creek. The natural depth in the creek was 1 to 3 feet at low tide, and on a bar at the mouth it was less than 1 foot.

In 1890 a project was adopted for making a channel 100 feet wide and 4 feet deep at mean low water up to the highway bridge, the entrance channel to be 2 feet deeper and to be protected by riprap jetties on either side, at an estimated cost of $46,000.

Up to July 1, 1896, $20,712.43 had been expended. The west jetty had been made 492 feet long and the east jetty 438 feet long, and a channel had been dredged 100 feet wide, 4 feet deep at mean low water, and 1,893 feet long.

During the past fiscal year dredging was begun to extend the channel. Before any useful work had been accomplished the contractor found his plant unsuited to the work and suspended operations.

The available funds will be applied to extending the channel.

The commerce of Browns Creek consists principally of shellfish, coal, lumber, etc., amounting in 1896 to 86,871 tons.

The object of the improvement is to provide a shelter for small oyster boats owned and operated in the vicinity. The channel already dredged is largely used by those boats for this purpose.

The annual value of the reported commerce is about nine times the cost of the completed improvement.

The only previous statement of freights carried by water is for the year 1895, when 36,080 tons was reported.

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July 1, 1896, balance unexpended	$4,287.57
June 30, 1897, amount expended during fiscal year	341.35
July 1, 1897, balance unexpended	3,946.22
July 1, 1897, amount covered by uncompleted contracts	3,390.00
July 1, 1897, balance available	556.22
Amount (estimated) required for completion of existing project	21,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix F 11.)

12. Canarsie Bay, New York.—Canarsie Bay is the northwest part of Jamaica Bay, at Canarsie Landing. The original natural depth to the landing was 4½ feet at low tide, the rise of tide being 4.7 feet.

In 1880 a project for improvement by dikes solely, subsequently modified to diking and dredging, was adopted in order to secure a channel 100 to 150 feet wide and 6 feet deep at mean low water, connecting Canarsie Landing with Big Channel, in Jamaica Bay; it was afterwards extended to include a south channel from the landing to Island Channel, to be 4 feet deep. The estimated cost was $88,000.

Up to July 1, 1896, $53,195.11 had been expended; two dikes had been built, one on the north side of the channel, 1,058 feet long, and one on the south side, 820 feet long; the main channel had been dredged to the full projected dimensions and the south channel had been made from 20 to 70 feet wide. Both channels had shoaled a foot or more in places.

During the past fiscal year shoals were removed from the main channel, making it 6 feet deep at mean low water, with width from 125 to 150 feet for its full length, 4,200 feet. A channel was also made 5 feet deep and 50 feet wide, connecting Canarsie Channel with Gophel Channel, 2,200 feet to the northeast.

The commerce of Canarsie Bay consists mainly of building materials, fertilizers, fish, and coal, amounting in 1896 to 50,087 tons. The annual value of this commerce is estimated at about five times the total cost of the improvement when completed.

This commerce is benefited by the increased depth to the landing, which obviates the delay for rising tide; the most important use of the channel is the transportation of passengers to summer resorts on Rockaway Beach.

The following is a statement of amounts of commerce reported for several years since 1890:

	Tons.		Tons.
1890	50,898	1894	133,425
1892	67,510	1895	148,564
1893	69,510		

July 1, 1896, balance unexpended	$11,804.89
June 30, 1897, amount expended during fiscal year	11,275.48
July 1, 1897, balance unexpended	529.41
Amount (estimated) required for completion of existing project	23,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix F 12.)

13. Bay Ridge Channel, the triangular area between Bay Ridge and Red Hook channels, and Red Hook and Buttermilk channels, in the harbor of New York.—These channels lie along the east shore of the Upper Bay,

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New York Harbor, and, in the sequence named, form an eastern channel between the Narrows and the East River, separated from the main channel by a broad shoal off the mouth of Gowanus Bay and by Governors Island. The lower part of this waterway, consisting of Bay Ridge and Red Hook channels, had a natural low-water depth of 7 to 12 feet; Buttermilk Channel had a natural depth of 26 feet in a narrow, crooked channel, with Buttermilk and Red Hook shoals on either side.

Prior to 1896 this improvement was carried on under two separate projects, one for improving Buttermilk Channel, adopted in 1880, and modified subsequently so as to provide for the removal of Buttermilk and Red Hook shoals to 26 feet depth at mean low water, at an estimated cost of $529,000, and one for improving Gowanus Bay channels, adopted in 1881 and subsequently modified so as to provide for dredging Bay Ridge Channel 800 feet wide and 26 feet deep, Red Hook Channel 400 feet wide and 26 feet deep, dredging the triangular area between these channels to the same depth, and making Gowanus Creek Channel 250 feet wide and 21 feet deep, at a total estimated cost of $1,124,400.

Up to July 1, 1896, $493,650.18 had been expended upon Buttermilk Channel and $639,939.14 upon the Gowanus Bay channels. Buttermilk Shoal, at the upper end of Buttermilk Channel, had been completely removed to 26 feet depth at mean low water, and 600 feet had been removed from the northwest side of the Red Hook Shoal to the same depth; the Bay Ridge Channel had been made 375 feet wide and 21 feet deep, with a depth of 26 feet for 175 to 200 feet of this width, and the Red Hook Channel had been made 350 feet wide and 21 feet deep, with 26 feet depth for 200 feet of this width.

By the terms of the river and harbor act of 1896 these works were consolidated and a small improvement of Gowanus Canal was added, and the adopted project now consists in dredging channels of 26 feet depth at mean low water, with widths as follows: For Bay Ridge Channel, 800 feet; for the triangular area between Bay Ridge and Red Hook channels, maximum width, 900 feet; for the Red Hook Channel, 400 feet; for Buttermilk Channel at Red Hook Shoal, 1,000 feet; and for dredging Gowanus Canal from Percival street to Hamilton Avenue Bridge to the extent of $5,000; at a total estimated cost of $837,300. The item in the act is as follows:

> Improving Bay Ridge Channel, the triangular area between Bay Ridge and Red Hook channels, and Red Hook and Buttermilk channels, in the harbor of New York, New York: Continuing improvement, two hundred thousand dollars: *Provided*, That the work shall be begun at the southerly end of Bay Ridge Channel and continue through it and the others in the order named, until each, as the work advances northerly, is completed in turn, so that each shall have a uniform mean low-water depth of twenty-six feet and width as recommended for each: *And provided further*, That out of said sum five thousand dollars shall be expended in dredging Gowanus Canal from Percival street to Hamilton Avenue Bridge: *And provided further*, That contracts may be entered into by the Secretary of War for the completion of the whole of said work, to be paid for as appropriations may be made from time to time by law, not exceeding in the aggregate six hundred and thirty-seven thousand three hundred dollars, exclusive of the amount herein and heretofore appropriated.

Up to July 1, 1896, no work had been done and no money expended under the project of 1896.

During the past fiscal year a contract has been entered into for completing the work called for by this project. Bay Ridge Channel has been dredged the required depth, 26 feet at mean low water, and the full width, 800 feet, up to Forty-third street, Brooklyn, a distance of about a mile; from Forty-third street to the upper end the channel has been made 270 feet wide and 26 feet deep and has been further widened,

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making a partial depth; work on this section is in progress. Gowanus Canal channel was completed, making it 18 feet deep at mean low water, with widths from 55 to 155 feet.

The appropriation made by act of Congress of June 4, 1897, will be applied to continuing the work in the order prescribed by the act of Congress of June 3, 1896.

The commerce of this part of New York Harbor consists of coal, grain, lumber, iron, and other freights, amounting in 1896 to 16,631,673 tons, valued at $317,986,702. The amount of commerce in transit through these channels can not be estimated.

The improvement already made has resulted in making these channels available for vessels of much greater draft than formerly.

BAY RIDGE CHANNEL, TRIANGULAR AREA BETWEEN BAY RIDGE AND RED HOOK CHANNELS, AND RED HOOK AND BUTTERMILK CHANNELS, NEW YORK.

July 1, 1896, balance unexpended		$200,000.00
Amount appropriated by sundry civil act approved June 4, 1897		350,000.00
		550,000.00
June 30, 1897, amount expended during fiscal year		94,439.69
July 1, 1897, balance unexpended		455,560.31
July 1, 1897, outstanding liabilities	$33,622.71	
July 1, 1897, amount covered by uncompleted contracts	376,255.16	
		409,877.87
July 1, 1897, balance available		45,682.44
Amount (estimated) required for completion of existing project		130,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		130,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

GOWANUS BAY CHANNELS, NEW YORK.

July 1, 1896, balance unexpended	$1,160.86
June 30, 1897, amount expended during fiscal year	101.86
July 1, 1897, balance unexpended	1,059.00

BUTTERMILK CHANNEL, NEW YORK.

July 1, 1896, balance unexpended	$2,699.82
June 30, 1897, amount expended during fiscal year	312.50
July 1, 1897, balance unexpended	2,387.32

(See Appendix F 13.)

14. Gowanus Creek Channel, New York Harbor.—That part of Gowanus Creek improved under the title of Gowanus Creek Channel is the part from the foot of Percival street on the east to the junction of Red Hook and Bay Ridge channels on the west.

Before improvement Gowanus Creek Channel had an available low-water depth of about 11 feet.

In 1881 a project for improvement of the several channels in Gowanus Bay was adopted which, as subsequently modified, provided for making a depth of 21 feet at mean low water in the Gowanus Creek Channel, with width extending to the harbor lines on either side. This was accomplished in 1893 under parts of appropriations made for the several channels, of which it is estimated that about $75,000 was applied to Gowanus Creek Channel.

Up to July 1, 1896, about $75,000 had been expended on this work.

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The channel had been made 21 feet deep at mean low water to the harbor lines on either side, and the project was completed.

Under the terms of the river and harbor act of 1896 a project was adopted for making the Gowanus Creek Channel 26 feet deep at mean low water between the foot of Percival street and Red Hook Channel, at a total estimated cost of $70,000.

During the past fiscal year the channel of Gowanus Creek between the foot of Percival street and Red Hook Channel, a distance of 3,000 feet, has been made 26 feet deep at mean low water and about 100 feet wide, under a contract not yet completed.

The commerce of Gowanus Creek Channel consists of coal, lumber, building materials, and miscellaneous goods, amounting in 1896 to 220,748 tons, valued at $2,403,015. About ten times this amount passes through Gowanus Creek to points above Percival street.

The improvement has resulted in admitting to this channel vessels of 15 feet greater draft than formerly.

The amount of commerce of Gowanus Creek in 1895 was reported as 366,299 tons.

July 1, 1896, balance unexpended		$25,000.00
June 30, 1897, amount expended during fiscal year		11,129.50
July 1, 1897, balance unexpended		13,870.50
July 1, 1897, outstanding liabilities	$7,867.00	
July 1, 1897, amount covered by uncompleted contracts	3,899.20	
		11,766.20
July 1, 1897, balance available		2,104.30
Amount (estimated) required for completion of existing project		45,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix F 14.)

15. Newtown Creek, New York.—This is a tidal stream about 4 miles long, extending from the eastern part of the city of Brooklyn to the East River, opposite Thirty-fourth street, New York City. It had formerly a depth of 12½ feet at mean low water at the mouth, decreasing to 4 feet at the head.

In 1880 a project for improvement was adopted which provided for deepening the channel near the mouth of the creek, at an estimated cost of $36,250, subsequently increased to $44,050. The river and harbor act of 1882 ordered a survey of the creek from its mouth to the Metropolitan Avenue Bridge, and under the appropriation of 1884 the project was extended to include this section of the creek and to make a channel throughout of 21 feet depth and 200 feet width at and near the mouth, decreasing to 10 feet depth and 100 feet width at the head, at a total estimated cost of $255,500.

Up to July 1, 1896, $197,500 had been expended; the channel had been made 18 feet deep and from 150 to 175 feet wide up to the Vernon Avenue Bridge, a distance of 2,300 feet, with a narrow channel of 21 feet depth; above this bridge it had been dredged to depths of 18 to 10 feet, with widths of 100 to 40 feet, to the head of the stream.

Under the terms of the river and harbor act of 1896 the project for Newtown Creek was modified to conform to this revised plan and estimate, an appropriation was made for beginning the work, and the Secretary of War was authorized to enter into contracts for completion of the modified project, the item in the act being as follows:

Improving Newtown Creek, part of the harbor at New York: Continuing improvement in accordance with modified project submitted March twenty-fifth, eighteen

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hundred and ninety-six, thirty thousand dollars: *Provided*, That contracts may be entered into by the Secretary of War for such materials and work as may be necessary to complete the modified project of improvement, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate four hundred and twenty thousand dollars, exclusive of the amount herein and heretofore appropriated.

During the past fiscal year a contract for completion of the project has been entered into, under which the channel 125 feet wide and 18 feet deep at mean low water has been extended from Vernon Avenue Bridge for a distance of 7,500 feet. Work is still in progress. The contract rates are very low and the work projected can be completed at a total cost of $213,000.

The appropriation of $183,000, made by act of Congress of June 4, 1897, for completing the improvement, will be applied to that end.

The commerce of Newtown Creek consists principally of coal, building materials, petroleum and petroleum products, chemicals, etc., amounting in 1896 to 2,740,482 tons, valued at $39,600,000. The annual value of this commerce is estimated at about one hundred times the amounts appropriated for the creek.

The improvement, so far as made, has rendered much of this commerce possible and has saved lighterage on much more.

July 1, 1896, balance unexpended		$30,000.00
Amount appropriated by sundry civil act approved June 4, 1897		183,000.00
		213,000.00
June 30, 1897, amount expended during fiscal year		20,953.67
July 1, 1897, balance unexpended		192,046.33
July 1, 1897, outstanding liabilities	$6,136.29	
July 1, 1897, amount covered by uncompleted contracts	167,878.26	
		174,014.55
July 1, 1897, balance available		18,031.78

(See Appendix F 15.)

16. Passaic River, New Jersey.—The navigable part of this river extends from Newark Bay to the city of Passaic, a distance of about 16 miles. The rise of the tide in the bay is 4.7 feet, decreasing to 3.3 feet at Passaic. Before improvement by the United States was begun the navigable depth to the city of Newark was about 7 feet at mean low water; from Newark to Passaic it was about 3 feet.

Under authority of the river and harbor act of 1872 a project was adopted for obtaining by dredging and diking a channel from Newark to Passaic City, to be from 50 to 200 feet wide and from 6 to 7½ feet deep, at an estimated cost of $123,924. This project was subsequently modified and extended and the estimated cost was increased to $193,822.

Under authority of the river and harbor act of 1880 a project for improving the river below Newark was adopted, which, with a subsequent modification and extension, provided for obtaining by dredging and diking a channel 200 feet wide and 10 feet deep at mean low water up to Center Street Bridge, Newark, at an estimated cost of $353,875.

Prior to 1892 appropriations for Passaic River were made separately for the parts above and below Newark. Under the appropriation made by the river and harbor act of 1892 the projects were consolidated, and the adopted project for improvement now consists in obtaining by dredging and diking a channel 200 feet wide and 10 feet deep at mean low water from below Passaic Light, in Newark Bay, to Center street, Newark; thence to the head of navigation at Passaic City a channel

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from 50 to 200 feet wide and from 6 to 7½ feet deep, at an estimated cost of $547,697.

Up to July 1, 1896, $433,759.88 had been expended; several small dikes had been built in the upper part of the river and 6,205 feet of diking at the head of Newark Bay. The channels had all been dredged to the required depth and width, except over one of the bars above Newark, but had shoaled and in some places had from 1 to 2 feet less than the projected depth.

During the past year a channel about 4,000 feet long was dredged southward from a point three-quarters of a mile below Passaic Light, making it 200 to 250 feet wide and 12 to 13 feet deep at mean low water; the work was done with the Government dredging plant.

The commerce of Passaic River consists mainly of building materials, iron and ores, fertilizers, coal, and miscellaneous freights, reported as amounting to 1,243,613 tons in 1896.

The improvements made have resulted in enabling the use of vessels of greater dratt than formerly and in reducing materially the amount of lighterage of cargoes.

The annual value of this commerce is estimated at about forty times the entire cost of the completed improvement.

Following is a statement of the tonnage of commerce reported for several years since 1890:

	Tons.
1890	1,763,645
1893	1,276,169
1895	1,258,966

July 1, 1896, balance unexpended	$19,590.12
June 30, 1897, amount expended during fiscal year	19,228.65
July 1, 1897, balance unexpended	361.47
Amount (estimated) required for completion of existing project	94,347.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix F 16.)

17. Channel between Staten Island and New Jersey.—This is an inland waterway about 17 miles long, connecting the upper bay, New York Harbor, with Raritan Bay, at the mouth of the Raritan River.

There is a natural depth of 15 feet or more at low tide through all of this channel, except for a length of about 1¾ miles eastward from Elizabethport, N. J., where there was a shoal with a crooked channel but 9½ feet deep.

In 1874 a project was adopted for making a channel 14 to 16 feet deep through this shoal, by dredging and diking, at an estimated cost of $443,210. The only work done under this project was the building of 2,237 feet of diking, at a cost of $50,000.

In 1880 a project was adopted which, with subsequent modifications, consists in dredging a channel through the shoal, to be 400 feet wide and 14 feet deep at mean low water, at an estimated cost of $210,000.

By the river and harbor act of 1896 the project was extended to provide for the application of $5,000 to dredging in Lemon Creek, Staten Island.

Up to July 1, 1896, $169,936.20 had been expended under the present project; the channel had been dredged to a depth of 14 feet at mean low water, with width of 400 feet at and west of the bend at Corner

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Stake Light and width of 250 to 300 feet east of the light. The channel at and west of the light had narrowed from the washing in of the banks. No work had been done in Lemon Creek.

During the past fiscal year the channel in the vicinity of the Corner Stake Light for a length of 4,000 feet was widened on the south side by an average width of 50 feet, principally removing material which had washed into the previously dredged channel.

At Lemon Creek a channel 8 feet deep at mean high water (about 3½ feet at low tide) was dredged 50 feet wide for a distance of 850 feet from deep water in the bay, and was extended 1,120 feet farther with width of 35 feet.

The commerce of the channel between Staten Island and New Jersey consists of oil, coal, and miscellaneous freights from tide-water termini; brick, clay, and fertilizers from manufactories along the waterway, together with the through traffic between Raritan Bay, Raritan and Elizabeth rivers, Woodbridge and Richmond creeks and New York Harbor.

The annual amount of freight so carried is about 9,000,000 tons, and its annual value is estimated at about three hundred times the cost of the present project.

July 1, 1896, balance unexpended	$13,063.80
June 30, 1897, amount expended during fiscal year	13,034.11
July 1, 1897, balance unexpended	29.69
Amount (estimated) required for completion of existing project	32,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	32,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix F 17.)

18. Elizabeth River, New Jersey.—This is a tidal stream which originally had an available high-water depth of 4 feet up to the head of navigation, at Broad street, Elizabeth, about 2⅝ miles above its mouth. The natural width of the stream was from 50 to 90 feet.

Under authority of the river and harbor act of 1879 a project was adopted for improving the river by dredging a channel 60 feet wide and 7 feet deep at mean high water up to the head of navigation, at an estimated cost of $25,530, increased in 1882 to $43,160 on account of the greater cost of the work.

Up to July 1, 1896, $39,938.61 had been expended; a channel of the required depth had been made up to Bridge street, about one-fourth mile below Broad street, Elizabeth, with widths from 30 to 60 feet. Parts of the channel had been redredged several times.

During the past fiscal year a contract for dredging has been entered into, but work has not yet been begun.

The available funds will be applied to restoring the depth of 7 feet at mean high water with as great width as practicable.

The commerce of this river consists of coal, building materials, and miscellaneous freights, reported in 1896 as amounting to 36,066 tons, valued at $173,760. It can now be delivered at Elizabeth wharves in vessels of greater draft than formerly.

The annual value of commerce is estimated at about four times the total cost of the improvement.

The following shows the reported amounts of commerce of Elizabeth River during several years since 1890:

	Tons.		Tons.
1890	40,340	1894	28,554
1893	28,554	1895	21,650

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July 1, 1896, balance unexpended	$3,221.39
June 30, 1897, amount expended during fiscal year	32.30
July 1, 1897, balance unexpended	3,189.09
July 1, 1897, amount covered by uncompleted contracts	2,800.00
July 1, 1897, balance available	389.09

(See Appendix F 18.)

19. Raritan River, New Jersey.—This river is a tidal stream from its mouth up to New Brunswick, N. J., a distance of 12 miles, where it is the eastern terminus of the Delaware and Raritan Canal.

Before improvement by the United States the channel to New Brunswick was obstructed by several extensive shoals, with depths of 6½ to 8½ feet at mean low water.

In 1878 a project for improvement was adopted providing for a channel 200 feet wide and 10 feet deep at mean low water from the mouth to the canal terminus at New Brunswick, to be obtained by dredging, diking, and rock excavation, at a total estimated cost of $2,093,662.05.

Up to July 1, 1896, $630,594.26 had been expended; four dikes had been completed and the fifth and last more than half finished. The channel had been made the full depth of 10 feet at mean low water to within 1,100 feet of the canal terminus, the lower 8½ miles being 200 feet wide and the upper part 100 feet wide; 400 feet additional length had been made 60 feet wide and 9 feet deep. The sand cuts had shoaled in places, so that the available depth was about 9 feet.

During the past fiscal year 8,694 tons of rock has been broken under contract, of which 7,249 tons has been dredged up and removed by the Government plant. The channel of 100 feet width and 10 feet depth has been extended to within 700 feet of the canal terminus.

Future appropriations will be applied to maintaining the dikes and channels, and to extending and widening the upper part of the channel as projected.

The commerce of this river consists principally of coal, ores, lumber, brick, clay, manufactured articles, and miscellaneous merchandise, amounting in 1896 to 1,136,974 tons, valued at about $18,000,000. As a result of the improvement larger vessels can be used than formerly and with less delay for tides.

The annual value of commerce is estimated at eight to nine times the estimated cost of the completed improvement.

The following shows the variations in amount of commerce reported for several years since 1885:

	Tons.		Tons.
1885	1,534,134	1893	1,446,658
1890	1,661,425	1894	1,138,692
1892	1,120,302	1895	975,101

July 1, 1896, balance unexpended		$20,655.74
June 30, 1897, amount expended during fiscal year		8,739.23
July 1, 1897, balance unexpended		11,916.51
July 1, 1897, outstanding liabilities	$5,165.70	
July 1, 1897, amount covered by uncompleted contracts	2,370.54	
		7,536.24
July 1, 1897, balance available		4,380.27

Amount (estimated) required for completion of existing project	1,442,412.05
Amount that can be profitably expended in fiscal year ending June 30, 1899	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix F 19.)

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20. South River, New Jersey.—South River is a narrow tidal stream tributary to the Raritan River at a point about 8 miles above its mouth and affording water communication to a large brick manufacturing district. Before the improvement of this stream was undertaken by the United States a private canal about three-fourths of a mile long had been dredged from near Washington, on the South River, to Sayreville, on the Raritan, shortening the sailing course by about 2 miles.

In 1880 the available depth through the canal was about 3½ feet, and thence to the head of navigation, 6.3 miles above Sayreville, about 2½ feet.

In 1880 a project for improvement was adopted which provided for correcting the canal outlet and for obtaining by dredging and diking a channel 100 feet wide and 8 feet deep to Washington, thence 6 feet deep to Bissetts, 3⅝ miles from the mouth, thence to Old Bridge, the head of navigation, 4 feet deep, at an estimated cost of $194,695, reduced in 1892 to $176,975.

Up to July 1, 1896, $82,424.05 had been expended, the mouth of the canal had been rectified, and six dikes had been built below Washington. A channel 50 to 75 feet wide and 8 feet deep had been dredged up to Washington, and parts of the channel above Washington had been made 6 feet deep. These channels had shoaled in several places.

During the past fiscal year shoals in the dredged channel below Washington were removed, making a continuous depth of 8 feet up to the landings, with minimum width of 50 feet.

Future appropriations will be applied to dredging the channels as proposed in the adopted project.

The commerce of South River consists principally of brick, clay, coal, etc., amounting in 1896 to 216,783 tons, valued at $1,200,000.

The increased depth obtained has made the transportation of these articles easier than formerly. The annual value of the commerce in 1896 is about seven times the cost of the improvement, when completed.

The following shows the reported commerce of South River for several years since 1890:

	Tons.		Tons.
1890	364,154	1894	160,500
1892	162,462	1895	177,794
1893	156,260		

July 1, 1896, balance unexpended	$5,575.95
June 30, 1897, amount expended during fiscal year	4,993.15
July 1, 1897, balance unexpended	582.80
Amount (estimated) required for completion of existing project	88,975.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix F 20.)

21. Raritan Bay, New Jersey.—Raritan Bay is the western part of the large triangular bay inclosed between Sandy Hook, the New Jersey shore, and Staten Island.

Prior to improvement, the deepest natural channel from Perth Amboy to the Atlantic Ocean followed the south shore of Staten Island for 4½ miles to Seguine Point, where it was separated from deep water beyond by a shoal 14½ feet deep, and there were two smaller shoals on the side of the channel opposite Wards Point, at the southwest end of Staten Island. From South Amboy to the Perth Amboy Channel at Great Beds Light the available depth was 12 feet.

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Under authority of the river and harbor act of 1881, a project was adopted for making the channel from Seguine Point out to deep water 300 feet wide and 21 feet deep at mean low water, at a cost of $126,500. In 1886, when appropriations had been made in excess of the estimated cost of this work, the project was extended to include deepening certain shoals off Wards Point, to improve the access to Seguine Point Channel. Under the terms of the river and harbor acts of 1890 and 1892 the project was extended to include a channel 300 feet wide and 15 feet deep from South Amboy to deep water near Great Beds Light, and the total estimated cost was increased to $357,875. To comply with the terms of the river and harbor act of 1896 the project was further extended so as to make the South Amboy Channel 300 feet wide and 21 feet deep, at an additional cost of $150,000. The present project for improvement, therefore, consists in making channels 21 feet deep at mean low water and 300 feet wide from Seguine Point to deep water outside at the bend opposite Wards Point, and from South Amboy to deep water near Great Beds Light, at a total estimated cost of $507,875.

Up to July 1, 1896, $302,465.79 had been expended; the Seguine Point Channel had been dredged to the full depth and width, but had shoaled so that the available depths were from 16 to 18 feet; the Wards Point Channel had been made 21 feet deep and 300 feet wide and remained in fair condition for navigation; the South Amboy Channel had been dredged 15 feet deep and 300 feet wide, and has shoaled from 1 to 3 feet.

During the past fiscal year the Seguine Point Channel was dredged so as to make 21 feet depth at mean low water for a width of 100 feet, and 19 feet depth or over for an additional 100 feet of width; the South Amboy Channel was made 21 feet deep for a width of 100 to 150 feet.

The commerce of Raritan Bay consists mainly of coal, brick, manufactures, and miscellaneous freights, amounting, in 1896, to 4,629,514 tons. The improvement already made has rendered it possible to use larger and deeper vessels than formerly, and with less delay for tides.

The annual value of this commerce is estimated at about sixty-two times the total estimated cost of the project when completed.

Following is the reported amount of commerce for several years since 1890:

	Tons.		Tons.
1890	3,845,866	1894	(*)
1892	(*)	1895	3,888,995
1893	(*)		

July 1, 1896, balance unexpended	$75,034.21
June 30, 1897, amount expended during fiscal year	70,918.17
July 1, 1897, balance unexpended	4,116.04
July 1, 1897, outstanding liabilities	46.67
July 1, 1897, balance available	4,069.37
Amount (estimated) required for completion of existing project	130,375.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix F 21.)

22. Mattawan Creek, New Jersey.—Before improvement by the United States this small tidal stream was obstructed at its mouth, in Keyport Harbor, by a mud flat, through which a narrow channel of 3 feet depth

* Reported the same as in 1890.

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existed, but was too crooked for use. Above this flat there was a 4-foot channel for a mile and a narrow channel 3½ feet deep for three-fourths of a mile farther and nearly to the head of navigation at Mattawan. The rise of tide is 4.9 feet.

Under authority of the river and harbor act of 1881, a project was adopted for improving the stream by dredging to make a channel 4 feet deep at mean low water, to be 100 feet wide up to Winkson Creek, nearly a mile from the mouth, and thence to the head of navigation to be 75 feet wide, at an estimated cost of $33,120.

Up to July 1, 1896, $35,978.49 had been expended. The channel had been made 4 feet deep at mean low water up to the Mattawan Steamboat Dock, with widths ranging from 40 to 100 feet, the greatest widths being generally in the lower part of the creek.

During the past fiscal year a contract for dredging has been entered into, but operations have not yet been begun.

The estimated amount for completion of the project had been appropriated in 1892, but owing to shoaling during the progress of work, the project is not yet completed to the proposed width. It is estimated that a channel sufficient for the requirements of local commerce can be maintained at an average annual cost of $3,000.

The commerce of Mattawan Creek consists mainly of farm produce, fertilizers, brick, coal, and miscellaneous freights, amounting in 1896 to 435,000 tons. The annual value of this commerce is estimated at about 110 times the total amount expended upon the improvement.

The improvement, as far as made, has given increased depth and width to the channel and has rendered navigation of the stream easier.

Following is a statement of the commerce of Mattawan Creek, as reported for several years since 1890:

	Tons.		Tons.
1890	187,850	1894	658,000
1892	326,500	1895	338,025
1893	578,700		

July 1, 1896, balance unexpended	$3,141.51
June 30, 1897, amount expended during fiscal year	7.65
July 1, 1897, balance unexpended	3,133.86
July 1, 1897, amount covered by uncompleted contracts	2,700.00
July 1, 1897, balance available	433.86
Amount required for maintenance in fiscal year ending June 30, 1899... Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	3,000.00

(See Appendix F 22.)

23. Keyport Harbor, New Jersey.—Keyport Harbor was originally accessible at low water only to vessels drawing less than 4 feet. Before its improvement was undertaken by the United States a 6-foot channel had been dredged at private expense, which had shoaled in 1872 to 5½ feet, and in 1882 to 5 feet, the range of tide being 4.9 feet.

A survey of Keyport Harbor was ordered by Congress in 1872, and a plan for improvement was submitted, contemplating dredging a channel from the vicinity of the steamboat dock to Raritan Bay, about 4,700 feet, to be 200 feet wide and 8 feet deep at mean low water; estimated cost $30,475. This project was adopted under the river and harbor act of 1882, but, on account of shoaling since the survey of 1872, the estimate of cost was then placed at $40,475.

Up to July 1, 1896, $40,269.32 had been expended. In 1883 a channel

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8 feet deep and from 160 to 200 feet wide had been dredged from the Keyport wharves to Raritan Bay. No further work was done until 1890, when this channel had almost completely filled; since then parts of it have been redredged, and July 1, 1896, the outer half of the channel was 7½ feet deep, the inner part being 8 feet deep for 35 feet width, and but 6 feet deep for 100 feet width.

During the past fiscal year a channel 1,100 feet long and 75 feet wide was dredged outward from the steamboat dock, making 8 feet depth where the depth prior to dredging was 6 feet. This channel includes the channel dredged in 1896, which had almost completely filled.

The estimated amount required for completion of the project has been appropriated, but on account of shoaling since the beginning of work the channel is not completed to the dimensions designed. If the channel contemplated in the project is to be made and maintained, further appropriations will be needed. It is estimated that a channel sufficient for the requirements of local commerce can be maintained at an average annual cost of $5,000.

The commerce of Keyport Harbor consists mainly of farm produce, fertilizers, brick, coal, and miscellaneous freights, amounting in 1896 to 540,200 tons. The annual value of this commerce is estimated at about 170 times the amount expended upon the improvement of the harbor.

The improvement, as far as made, has resulted in a channel through which the ordinary commerce of the harbor can pass with little delay for tides.

The following table shows the amount of commerce reported for several years since 1890:

	Tons.		Tons.
1890	222,965	1894	687,169
1892	(*)	1895	434,625
1893	(*)		

July 1, 1896, balance unexpended	$2,705.68
June 30, 1897, amount expended during fiscal year	2,489.29
July 1, 1897, balance unexpended	216.39
July 1, 1897, outstanding liabilities	6.67
July 1, 1897, balance available	209.72
Amount required for maintenance in fiscal year ending June 30, 1899... Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	5,000.00

(See Appendix F 23.)

24. Shoal Harbor and Compton Creek, New Jersey.—Shoal Harbor is on the south shore of Sandy Hook Bay, 5 miles from Sandy Hook. Compton Creek is a narrow stream emptying into Shoal Harbor, with depths of 3 to 6 feet up to a highway bridge, about one-fourth of a mile above its mouth, and is used as a harbor for small vessels. The entrance to the creek is obstructed by a broad, flat shoal, which had originally less than 1 foot depth at mean low water. The rise of tide is 4½ feet.

The project for improvement, adopted under authority of the river and harbor act of 1890, proposed a channel 4 feet deep at mean low water, connecting Compton Creek with Sandy Hook Bay, to be 150 feet wide in the bay and 75 feet wide in and near the mouth of the creek, to be protected by a dike if necessary. The estimated cost is $64,130.

Up to July 1, 1896, $10,933.91 had been expended on this improvement. A channel 4 feet deep and 75 feet wide had been dredged from

* No report.

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inside the mouth of the creek to the 1-foot contour in the bay, a distance of 1,655 feet. This channel already affords a slight relief to the small vessels which harbor in the creek.

During the past fiscal year a channel was dredged 1,625 feet outward from the steamboat dock, making 4 feet depth at mean low water for a width of 25 feet for the upper 1,200 feet, and width of 75 feet for the lower 425 feet. This channel partly overlies the one previously dredged, which was found to have shoaled.

Future appropriations should be applied to extending and completing the channel as projected.

The commerce consists mainly of farm and fishing products, fertilizers, and miscellaneous freights, amounting in 1896 to 167,000 tons. The annual value of this commerce is estimated at about five times the cost of the improvement when completed.

The advantage realized from the improvement, as far as now made, is an increase of 2 feet in depth of the entrance to Compton Creek.

Following is a statement of the amounts of commerce reported for several years since 1890:

	Tons.		Tons.
1890	35,500	1894	106,000
1892	62,000	1895	152,000
1893	69,500		

July 1, 1896, balance unexpended	$5,066.09
June 30, 1897, amount expended during fiscal year	5,007.21
July 1, 1897, balance unexpended	58.88
Amount (estimated) required for completion of existing project	48,130.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	15,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix F 24.)

25. Shrewsbury River, New Jersey.—This river consists of two large tidal basins in eastern New Jersey, which discharge through a common outlet into Sandy Hook Bay. Before improvement by the United States was undertaken the available depth to Oceanic, on the North Branch and 5 miles above the mouth, was 3½ feet; to Branchport, on the South Branch and 9 miles from the mouth, it was 2½ feet.

Under the river and harbor act of 1871, a project was adopted for making 6 feet depth across certain bars in the lower part of the river; this was completed in 1873 at a cost of $19,000. The channels soon filled up.

Under authority of the river and harbor act of 1879, a project was adopted for making, by dredging and diking, a channel 6 feet deep at mean low water and from 150 to 300 feet wide through the shoals in the main stem and both branches, at an estimated cost of $142,086. Owing to the necessity of frequent redredging and to the prices being higher than anticipated, the estimate for completion was increased to $234,062.

Up to July 1, 1896, $218,963.98 had been expended upon this project. Channels 6 feet deep, with widths from 60 to 200 feet, had been dredged and nine dikes had been built. The full depth and width of the dredged channels did not remain permanent and several of the bars had been redredged more than once. The outer channel had been deepened by scouring to 7 feet at mean low water, but the available depth through the North and South branches was about 4 feet.

During the past winter the sea broke through the narrow neck of

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Sandy Hook peninsula which separates Shrewsbury River from the Ocean and deposited a bar of sand completely across the east channel at Island Beach, filling the channel above high-water level, almost completely suspending navigation in the river. The appropriation of 1896 was applied to opening the channel west of Island Beach, and to deepening three small shoals in the river. A channel 100 feet wide and 6 feet deep at mean low water was cut through west of Island Beach for a distance of 2,400 feet, connecting deep water above and below and restoring navigation for the season of 1897. The work is nearly completed.

Future appropriations should be applied to maintaining the channels of 6 feet depth with width of 100 to 150 feet and to maintaining and extending the dikes. The channel east of Island Beach can not be reopened until the inlet breach in the Sandy Hook peninsula is permanently closed. It is estimated that channels sufficient for the requirements of local commerce can be maintained at an average annual cost of $10,000.

The commerce of Shrewsbury River consists mainly of coal, farm produce, fertilizers, fish, and miscellaneous freights, of which 868,130 tons was reported in 1896. The annual value of this commerce is estimated at about forty times the amount expended upon the project for improvement.

As a result of the improvement of this river, the vessels carrying the above freights are less dependent on tides than formerly.

Following is a statement of the tonnage of freights reported for several years since 1890:

	Tons.		Tons.
1890	556,500	1894	939,000
1892	672,000	1895	630,100
1893	737,000		

July 1, 1896, balance unexpended	$15,036.02
June 30, 1897, amount expended during fiscal year	7,289.03
July 1, 1897, balance unexpended	7,746.99
July 1, 1897, outstanding liabilities	6,570.79
July 1, 1897, balance available	1,176.20
Amount (estimated) required for completion of existing project	62.00
Amount required for maintenance in fiscal year ending June 30, 1899	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix F 25.)

26. Removing sunken vessels or craft obstructing or endangering navigation.—1. The schooner *Lizzie D. Saunders* sunk on shore at one of the Thimble Islands, east of Branford, Conn., in October, 1895, and afterwards fell off into 12 feet of water, where she was a source of danger to vessels entering the harbor at Thimble Islands. In July, 1897, the wreck was lifted, towed away, and sunk in 17 fathoms of water in Long Island Sound.

2. The coal barge *Mist* was abandoned in Raritan Bay, New Jersey, in December, 1895. She was removed from the channel in April, 1896, any finally disposed of in July, 1896.

3. The schooner *Anna Augusta* was run down and sunk in Raritan River, New Jersey, in 13 feet depth of water, on September 14, 1896, where she was abandoned. The wreck was removed in January, 1897, and placed behind one of the dikes in the Raritan River.

4. The steam tug *William Horre* exploded her boiler and sunk in

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Gowanus Canal, New York Harbor, on October 23, 1896, and lay in 12 feet depth of water off Smith street, Brooklyn. The wreck was removed in January, 1897. It was found to be completely shattered by the explosion and worthless.

5. The schooner *John B. Conover* grounded and sunk in Sheepshead Bay, New York, on April 8, 1897, and lay on the south side of the channel in depths of 8 to 16 feet at low tide. This wreck was removed June 28, 1897. It was found to be old, badly strained, and worthless.

The total amount expended during the year on removal of wrecks was $1,865.07.

(See Appendix F 26.)

EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The preliminary examinations and surveys of the following localities, required by the act of June 3, 1896, were made by the local engineer, Maj. H. M. Adams, Corps of Engineers, and reports thereon submitted:

1. Preliminary examination for channel connecting Flushing Bay and Newtown Creek, New York.—Major Adams submitted report of examination September 29, 1896. It is his opinion, concurred in by the division engineer, Col. (now Brig. Gen.) John M. Wilson, Corps of Engineers, and by the Chief of Engineers, that the construction of a channel between Flushing Bay and Newtown Creek is not worthy to be undertaken by the United States under existing conditions. The report was transmitted to Congress and printed in House Doc. No. 60, Fifty-fourth Congress, second session. (See also Appendix F 27.)

2. Preliminary examination of Roslyn Harbor, New York.—Major Adams submitted report of examination January 15, 1897. For the reasons given, he is of the opinion that the improvement of Roslyn Harbor is a work not worthy of being undertaken by the United States, and this opinion is concurred in by the division engineer, Colonel (now Brigadier-General) Wilson, and by the Chief of Engineers. The report was transmitted to Congress and printed in House Doc. No. 215, Fifty-fourth Congress, second session. (See also Appendix F 28.)

3. Preliminary examination of harbor at Oyster Bay, New York.—Major Adams submitted report of examination January 8, 1897. It is his opinion, concurred in by the division engineer, Colonel (now Brigadier-General) Wilson, and by the Chief of Engineers, that the improvement of the harbor upon the plan desired is not a work worthy to be undertaken by the United States. The report was transmitted to Congress and printed in House Doc. No. 201, Fifty-fourth Congress, second session. (See also Appendix F 29.)

4. Preliminary examination of Lloyds Harbor, with a view to its connection with Cold Spring Bay, New York.—Major Adams submitted report of examination January 8, 1897. He is of opinion that the connection of Lloyds Harbor with Cold Spring Bay by a navigable channel is not an improvement worthy to be undertaken by the United States, and his opinion is concurred in by the Division Engineer, Colonel (now Brigadier-General) Wilson, and by the Chief of Engineers. The report was transmitted to Congress and printed in House Doc. No. 204, Fifty-fourth Congress, second session. (See also Appendix F 30.)

5. Preliminary examination of Northport Harbor, New York.—Major Adams submitted report of examination November 10, 1896. In the opinion of Major Adams and of the division engineer, Colonel (now Brigadier-General) Wilson, Northport Harbor is worthy of improvement

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by the United States to the extent of deepening the channel along the village water front to make it from 9 to 10 or perhaps 12 feet deep and 100 feet wide for a distance estimated at 2,000 feet. The Chief of Engineers concurred in this opinion in so far as to advise the making of a survey of the harbor, estimated to cost $250, upon the results of which a more reliable opinion can be formed as to the extent of the improvement justified by the commerce involved. The report was transmitted to Congress and printed in House Doc. No. 90, Fifty-fourth Congress, second session. (See also Appendix F 31.)

6. Preliminary examination of Smithtown Harbor, New York.—Major Adams submitted report of examination December 15, 1896. It is his opinion that the improvement of this locality is not worthy to be undertaken by the United States, and his views are concurred in by the division engineer, Colonel (now Brigadier-General) Wilson, and by the Chief of Engineers. The report was transmitted to Congress and printed in House Doc. No. 128, Fifty-fourth Congress, second session. (See also Appendix F 32.)

7. Preliminary examination of channels to Far Rockaway and Inwood, N. Y.—Major Adams submitted report of examination January 18, 1897. In the opinion of the local officer, this improvement is not worthy of being undertaken by the United States, and his views are concurred in by the division engineer, Colonel (now Brigadier-General) Wilson, and by the Chief of Engineers. The report was transmitted to Congress and printed in House Doc. No. 216, Fifty-fourth Congress, second session. (See also Appendix F 33.)

8. Preliminary examination of Babylon Creek, New York.—Major Adams submitted report of examination January 20, 1897. He is of opinion that the improvement of this stream is not a work worthy to be undertaken by the United States, and his views are concurred in by the division engineer, Colonel (now Brigadier-General) Wilson, and by the Chief of Engineers. The report was transmitted to Congress and printed in House Doc. No. 222, Fifty-fourth Congress, second session. (See also Appendix F 34.)

9. Survey of East Chester Creek, New York, with a view to extending improvement to head of tide water.—Major Adams submitted report of survey December 19, 1896. The plan presented in the report provides for extending the present improvement to the crossing of the old post road by means of an artificial channel through private lands, 100 feet wide at bottom and 9 feet deep at mean high water, estimated to cost $27,000. This estimate makes no provision for cost of obtaining right of way through private lands, and contemplates deposit of dredgings upon such lands. For reasons given, the local officer is of the opinion that the proposed improvement is not worthy of being undertaken by the United States, and this opinion is concurred in by the division engineer, Colonel (now Brigadier-General) Wilson, and by the Chief of Engineers. The report was tranmitted to Congress and printed in House Doc. No. 147, Fifty-fourth Congress, second session. (See also Appendix F 35.)

10. Survey of Bay Ridge Channel, the triangular area between Bay Ridge and Red Hook channels, and Red Hook and Buttermilk channels, New York Harbor, with a view to making one continuous channel, with a least depth of 30 feet at mean low water for a width of 1,000 feet, and also for a continuous channel with a least depth of 35 feet at mean low water for a width of 1,200 feet.—Major Adams submitted report of survey February 24, 1897. The locality in question is at present being improved, and, under the provisions of the same act which authorized

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this survey, a continuing contract has been made for dredging these channels to a depth of 26 feet at mean low water and widths varying from 400 feet to 1,000 feet. In addition to the work already done and provided for, Major Adams estimates that the cost of securing the channel 30 feet deep at mean low water and 1,000 feet wide, as specified by the act, will be $2,000,000; of securing the channel 35 feet deep at mean low water and 1,200 feet wide, $5,300,000. The report was transmitted to Congress and printed in House Doc. No. 337, Fifty-fourth Congress, second session. (See also Appendix F 36.)

11. Survey of Gowanus Creek, New York, with a view of obtaining a depth of 30 feet at mean low water.—Major Adams submitted report of survey February 24, 1897. Work is now being carried on at this locality under a project which provides for improving Gowanus Creek Channel, by deepening it to 26 feet at mean low water, from the foot of Percival street to its junction with the Red Hook Channel, and the local officer estimates the cost of making this channel 30 feet deep at mean low water between the harbor lines to be $58,000, in addition to the cost of completing the project for 26 feet depth. The report was transmitted to Congress and printed in House Doc. No. 336, Fifty-fourth Congress, second session. (See also Appendix F 37.)

12. Survey of channel between the Battery and Governors Island, New York, with a view to making a channel continuous with Buttermilk Channel 30 feet in depth and 1,200 feet in width.—Major Adams submitted report of survey February 24, 1897. He states that the least expensive method of securing for this channel the width and depth contemplated in the act would involve dredging along the northeast shore of Governors Island and removing part of Dimond Reef, at a total estimated cost of about $500,000, but that this plan would afford an increased depth over only that part of the channel which is least used and would leave the ragged edge of Dimond Reef a very serious source of danger. He further states that when the improvement of this channel is undertaken the work should include all that is necessary or practicable to relieve the crowded condition of the locality and make it accessible from East River and the upper end of Buttermilk Channel; that Dimond Reef and Coenties Reef should be completely removed; that the shoal of 26 feet depth between this channel and Buttermilk Channel should be deepened, and the shoals along the shores at the Battery and Governors Island should be removed. It is estimated that such an improvement of the channel would cost $2,210,000. The division engineer, Col. G. L. Gillespie, Corps of Engineers, concurs in the views of the local officer that the improvement of the channel in the manner proposed, including the deepening of the shoals along the shores of the channel, is a work of public importance which is worthy to be undertaken by the United States, and which is justified by the interests of commerce involved. The report was transmitted to Congress and printed in House Doc. No. 334, Fifty-fourth Congress, second session. (See also Appendix F 38.)

13. Survey of Elizabeth River, New Jersey.—Major Adams submitted report of survey February 16, 1897. The plan of improvement presented provides for dredging so as to obtain a channel from 6 to 7 feet deep at mean high water from the mouth of the river up to Bridge Street Bridge at the city of Elizabeth. The cost is estimated at $12,000. An annual expenditure, estimated at $6,000, would be required to maintain the proposed channel depth. It is the opinion of the local officer that the proposed improvement is not worthy of being undertaken by the United States, as the increased depth to be obtained by dredging

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would last but one or two years, and that the work of maintenance would involve an expense not justified by the interests of commerce. These views are concurred in by the division engineer, Colonel Gillespie, and by the Chief of Engineers. The report was transmitted to Congress and printed in House Doc. No. 322, Fifty-fourth Congress, second session. (See also Appendix F 39.)

14. Survey of Rahway River, New Jersey, from its mouth to Main Street Bridge, Rahway.—Major Adams submitted report of survey January 25, 1897. The plan of improvement presented provides for dredging a channel 8 feet deep at mean high water and 100 feet wide from First Island up to Main Street Bridge, a distance of 2 miles, at an estimated cost of $108,000. A channel exceeding this depth and width already exists up to First Island. It is the opinion of the local officer, based upon the reasons given, that the proposed improvement is not justified by the interests of commerce involved. The division engineer, Colonel (now Brigadier-General) Wilson, concurred in this opinion. The report was transmitted to Congress and printed in House Doc. No. 254, Fifty-fourth Congress, second session. (See also Appendix F 40.)

IMPROVEMENT OF RIVERS AND HARBORS IN SOUTHERN NEW JERSEY, OF DELAWARE RIVER AND BAY, AND OF WATERS TRIBUTARY THERETO, NEW JERSEY, PENNSYLVANIA, AND DELAWARE.

This district was in the charge of Maj. C. W. Raymond, Corps of Engineers, with Lieut. Spencer Cosby, Corps of Engineers, under his immediate orders.

1. Delaware River, New Jersey and Pennsylvania.—Trenton, the head of natural navigation on the Delaware River, is about 30 miles above the upper part of the port of Philadelphia. In its original condition this part of the river was obstructed by shoals at the following localities: Between Bordentown and Trenton, a distance of about 5 miles, a narrow and circuitous channel existed, which carried from 3 to 6 feet at mean low water; at Kinkora Bar, about 9 miles below Trenton, a shoal carrying 7½ feet, and at Five Mile Bar, at the upper part of Philadelphia, a shoal across the Pennsylvania channel carrying only 3 to 4 feet at mean low water, there being, however, 13 feet of water past Five Mile Bar in the New Jersey channel passing south of Petty Island.

Below Philadelphia the river in its original condition presented obstructions at Mifflin Bar which reduced the depth at mean low water to 17 feet; at Schooner Ledge and Cherry Island Flats to 18 feet; at Bulkhead Shoal and Dan Baker Shoal to about 20 feet, and at Duck Creek Flats to about 20 feet. In that part of the Delaware River between Trenton, N. J., and Bridesburg, Pa., efforts in the past have been directed toward relieving commerce from the obstructions which exist in the upper 9 miles of the river and deepening the channel across Kinkora Bar.

Previous to 1885 the efforts to improve the river between Philadelphia and the bay were confined to dredging, except at Schooner Ledge, where solid rock was removed under appropriations for special localities, and also under general appropriations for the Delaware River below Bridesburg.

A Board of Engineers, convened by direction of the Secretary of War for the purpose of considering the subject of the permanent improvement of Delaware River and Bay, recommended, under date of January 23, 1885, the formation of a ship channel from a point opposite Philadelphia and about midway between the American Shipbuilding Company's yard and the Gas Trust Wharf to deep water in Delaware Bay,

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having a least width of 600 feet and a depth of 26 feet at mean low water. The formation of such a channel was to be obtained, except at Schooner Ledge, where rock would require to be removed, by regulating the tidal flow by means of dikes, with recourse to dredging where necessary as an aid to such contracting and regulating works.

The estimated cost of obtaining a channel of the above dimensions was about $2,425,000, which covers the estimated cost of the permanent improvement of the Delaware River between the upper part of Philadelphia and deep water in the bay. The annual cost of maintenance was estimated at 10 per cent of the original cost for dredging and 1 per cent of the original cost for dikes. This estimate of cost does not include the improvement of Philadelphia Harbor, which is a separate project.

The entire amount expended on the improvement of the Delaware River from 1836 to June 30, 1896, under appropriations both for special localities and the general river was $2,326,392.23, of which $119,243.06 was expended on that part of the river between Trenton and Philadelphia. As the result of this expenditure there was at the latter date a channel of navigable width and 6 feet deep at mean low water through Perriwig Bar; a channel of navigable width and 7½ feet deep through the bars between Bridesburg and Bordentown; a channel through Kinkora Bar 8½ feet deep; a channel through Five Mile Bar with a least width of 600 feet and 22.3 feet deep; a channel 600 feet wide and 26 feet deep through the shoal areas at Port Richmond; a channel 600 feet wide and 26 feet deep at Otis Street Wharf; a channel through Mifflin Bar about 24 feet deep; a channel through Schooner Ledge 24 feet deep, except over a small area where the depth was 23 feet; a channel through Cherry Island Flats with a minimum depth of 18.3 feet, and a channel through Pennsville Shoals and Bulkhead Bar 26 feet deep.

The channel between Philadelphia and Camden across Smith Island Bar had been improved by the formation of a dredged cut, protected by revetment, so as to give a channel 100 feet wide with a minimum depth of 6 feet at mean low water. The revetment has been removed in the work of improving the harbor of Philadelphia.

During the fiscal year ending June 30, 1897, the sum of $80,738.79 was expended in surveys and examinations, in dike construction, and in dredging at Cherry Island Flats, Dan Baker Shoal, and Duck Creek Flats. The sum of $54,350.35 was expended in adjusting the losses of contractors resulting from the annulment of the contract for the construction and repair of dikes at Reedy Island and Listons Point, in consequence of the provisions of the river and harbor act of June 3, 1896, and the sum of $2,428.40 was expended in rebuilding and enlarging the dike at Fort Mifflin, in accordance with provisions in the river and harbor act of June 3, 1896.

The changes during the past fiscal year are summarized as follows:

The channel through Five Mile Bar has a depth of 25 feet at mean low water over its whole width. At Mifflin Bar the channel has a least depth of 23.4 feet. At Cherry Island Flats the minimum depth is 26 feet. At Bulkhead Bar the minimum depth is 26½ feet. Dredging is in progress at Cherry Island Flats, Dan Baker Shoal, and Duck Creek Flats. The dike at Fort Mifflin has been reconstructed and repaired for a distance of 2,100 feet.

Under authorities granted by the Secretary of War, the city of Philadelphia is now improving the channel at Schooner Ledge and has made contracts for improvements at Greenwich Point and Mifflin Bar. In view of the work thus provided for by the city and the low prices for

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dredging obtained in recent contracts, the estimated cost of completing the improvement in accordance with the approved project has been reduced from $805,000 to $300,000.

The benefits to navigation resulting from the improvement have been great. Previous to the improvement vessels of deep draft were compelled to utilize the high water of two tides in order to ascend the river to Philadelphia. They can now make the whole trip in a single tide.

For 1890 the total foreign freight movement of the Delaware River was estimated at 2,922,994 tons, and the total domestic freight movement at 8,433,276 tons. For 1896 the total foreign freight movement is estimated at 3,026,803 tons, and the total domestic freight movement at 12,241,562 tons. There appears to have been no important increase in foreign freight movement, and as the greater part of the domestic freight is caried in vessels of moderate draft, the increase in its movement can not be considered as due to the improvement of the river. Both the foreign and domestic freight movements were less in 1896 than in 1895. The total value of the freight moved upon the river in 1896 is estimated at $623,896,493.

July 1, 1896, balance unexpended		$645,607.77
June 30, 1897, amount expended during fiscal year		137,517.54
July 1, 1897, balance unexpended		508,090.23
July 1, 1897, outstanding liabilities	$18,281.31	
July 1, 1897, amount covered by uncompleted contracts	245,998.59	
		264,279.90
July 1, 1897, balance available		243,810.33
Amount (estimated) required for completion of existing project		300,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		300,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix G 1.)

2. Harbor between Philadelphia, Pa., and Camden, N. J.—At the time of adoption of the present project the islands in the Delaware River between Philadelphia and Camden compelled the flood and ebb currents to pursue different paths, narrowed the existing channels, and prevented the extension of wharves necessary for the purposes of commerce. The plan of improvement originally adopted by Congress provides for the removal of Smith and Windmill islands and a part of Petty Island, and the formation of a channel of ample depth and about 2,000 feet in width from Kaighn Point to Fishers Point. The project contemplates the advance of wharves and bulkheads on both the Philadelphia and Camden shores during the progress of the work. The excavation is to be done by the General Government. The advance of wharves and bulkheads is under the control of the local authorities and private owners, a portion of the material to be removed by the Government being considered available for the necessary filling. The estimated cost of the work to be done by the United States, exclusive of the cost of the islands, was $3,500,000.

The project was modified by Congress in the sundry civil act approved March 3, 1891, by authorizing a change in the line limiting the excavation on Petty Island, and by requiring that all material removed under appropriations made to that date should be deposited and spread on League Island. The latter requirement was revoked by Congress in the river and harbor act approved July 13, 1892, which provides that the material removed may be deposited in any place or places approved by the engineer officer in charge of the work.

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The amount expended under the project to June 30, 1896, was $2,138,807.69. At that date all the piling and revetment had been removed, 15,008,921 cubic yards of material, scow measurement, had been excavated by dredging, and 2,989,858 cubic yards had been deposited on League Island.

During the fiscal year ending June 30, 1897, 3,956,027 cubic yards of material, scow measurement, was dredged from Smith and Petty islands and the adjacent shoals, and 594,766 cubic yards, scow measurement, was deposited on League Island, completing the fill.

Smith and Windmill islands were dredged to an average depth of 25 feet below mean low-water mark, and the north side of Petty Island was dredged back so as to make the average low-water width of the Pennsylvania channel at that locality about 1,900 feet. Work was carried on under a contract with the American Dredging Company, dated June 1, 1893.

The total amount of work accomplished to June 30, 1897, is as follows:

Material removed by dredging, scow measurement	cubic yards	20,166,739
Piling and revetment removed	linear feet	24,848
Dredged material deposited and spread on League Island, scow measurement	cubic yards	3,584,624

Decided progress has been made in the reconstruction of the water fronts. Up to June 30, 1897, thirteen piers had been completed to the new lines, and one other was under construction.

During the fiscal year ending June 30, 1898, it is expected that the improvement will be completed with the funds now available.

The foreign freight movement of the port of Philadelphia for 1896 is estimated at 3,826,803 tons, and the domestic freight movement at 12,241,562 tons. It can not be shown that the improvement has increased the amount of commerce, but it has greatly facilitated navigation.

July 1, 1896, balance unexpended		$802,192.31
Amount appropriated by sundry civil act approved June 4, 1897		694,000.00
		1,496,192.31
June 30, 1897, amount expended during fiscal year		695,661.08
July 1, 1897, balance unexpended		800,531.23
July 1, 1897, outstanding liabilities	$354,793.33	
July 1, 1897, amount covered by uncompleted contracts	445,737.90	
		800,531.23

(See Appendix G 2.)

3. Schuylkill River, Pennsylvania.—When the improvement was commenced in 1870 there was a channel of entrance into the mouth of the river of only 10 feet at mean low water.

The original project under which work was commenced in 1870 proposed the formation of a channel 100 feet wide, with a depth of 20 feet from the mouth of the river to Gibson Point, about 4 miles, and a depth of 18 feet thence to Chestnut Street Bridge, in Philadelphia, about 3 miles.

In 1875 and 1883 this project was amended so as to increase the low-water channel between the mouth and Girard Point, a distance of about 1 mile, to 400 feet wide and 24 feet deep, and from Girard Point to Gibson Point, about 3 miles, to 250 feet wide and 20 feet deep. In 1892 the project was again modified so as to provide for the construction of dikes to maintain a navigable depth at the mouth. The estimated cost of the entire improvement was $529,959.

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The amount expended upon this project to June 30, 1896, was $500,966.29. This expenditure had resulted in the formation of a channel about 150 feet wide and from 18 to 21.3 feet deep at mean low water across the bar at the river's mouth; a channel about 250 feet wide and from 20 to 24 feet deep from inside the bar to Gibson Point, except at Yankee Point, where the width is 300 feet, and between Penrose Ferry Bridge and Yankee Point, where the 20-foot channel has narrowed to from 50 to 200 feet; and thence to Chestnut Street Bridge a channel of navigable width and from 14 to 20 feet deep.

During the past fiscal year, 62,983 cubic yards of material, scow measurement, was dredged from the bar at the mouth of the river. The average depth of the channel across the bar along the line of deepest water is now 27.5 feet at mean low water.

The city of Philadelphia is now improving the channel under authorities granted by the Secretary of War under dates of September 3, 1895, and May 14, 1896. Dredging was commenced on November 13, 1895, and was in progress at the close of the past fiscal year. The total amount dredged and placed ashore is about 91,830 cubic yards as measured in the dump. This work has resulted in the formation of a channel with a mean low-water depth of 22 feet and a width of 250 feet for a distance of half a mile above the Penrose Ferry Bridge. This improvement can be completed in accordance with the adopted project with funds now available. The river and harbor act of June 3, 1896, provides for a survey of the river with a view to further improvement. This survey was in progress at the end of the fiscal year.

The commercial interests of this river are of great and increasing value and importance. At Girard Point are located large grain elevators and wharves. At Gibson Point and Point Breeze, which are near each other and closely related as to commercial requirements, are the large storage tanks and wharves of the petroleum refineries. The interests assembled at these three points cover mainly the commerce of the river, and both the grain and oil trade require deep-draft vessels for the convenient and economical transaction of their business. Channel depths are needed which will permit the passage of vessels drawing 24 feet of water at all stages of the tide. The total freight movement for the year 1896 is estimated at 3,214,483 tons, and its value at $34,297,608.

July 1, 1896, balance unexpended	$24,033.71
June 30, 1897, amount expended during fiscal year	9,559.95
July 1, 1897, balance unexpended	14,473.76

(See Appendix G 3.)

4. Ice harbor at Marcushook, Pa.—This work, in its present plan, was commenced in 1866, the object being to provide a harbor in the Delaware River to protect vessels against moving ice.

In 1785 the Commonwealth of Pennsylvania built, for the convenience of commerce, piers at Marcushook, extending from the shore line into the river. It is assumed that at some subsequent time these shore piers were turned over to the United States, since in 1829 an appropriation was made of $5,000 for repairing these piers, improving the harbor, and removing obstructions. No further appropriation was made until 1866.

At this latter date the project was adopted for the construction of detached piers in the harbor, consisting of stone superstructures upon crib foundations filled with stone, together with the deepening of the harbor by dredging.

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In 1881 it was proposed to increase the area of the harbor by the construction of a bulkhead about 1,800 feet in length, parallel to the shore line and about 150 feet outside of high-water line, and the deepening of this added area by dredging. Nothing was done toward carrying into effect the modification of 1881, on account of the objections of some of the abutting property owners, and in 1881 this hitherto proposed modification was abandoned and an increased depth proposed for the areas protected by the detached piers outside of the natural shore line of the river.

The amount expended from 1866 to June 30, 1896, was $211,584.28, which was applied to the construction of two landing piers, the deepening of the protected area by dredging, the placing and replacing of mooring piles, repairs to piers and mooring piles, and the necessary examinations.

During the past fiscal year no work has been done. During the current fiscal year it is proposed to make moderate repairs with funds now available.

This harbor is of great value to vessels during the prevalence of ice in the river. The cost of its maintenance is trifling in comparison with the benefit derived from it.

July 1, 1896, balance unexpended	$2,415.72
July 1, 1897, balance unexpended	2,415.72

(See Appendix G 4.)

5. *Construction of iron pier in Delaware Bay near Lewes, Del.*—The original project for this work proposed the construction of a landing pier about 1,700 feet in length, extending from the shore south of the breakwater into Delaware Bay, to a depth of 22 feet at mean low water, the pier to consist of a substructure of wrought-iron screw piles surmounted with a timber superstructure. The work was commenced in 1871 and completed, except as to superstructure, in 1880.

The amount expended to June 30, 1890, was $368,453.66, and resulted in the construction of 1,155 linear feet of pier 21 feet in width, and 546 linear feet 42 feet in width, or a total length of 1,701 feet. The depth of water at the outer end of the pierhead was about 21 feet at mean low water.

During the fiscal year ending June 30, 1891, $7,033 was expended in replacing about 200 linear feet of the pier destroyed by the collisions of wrecked vessels in 1889, and in placing fender piles along 1,200 linear feet of the shore arm of the pier.

During the fiscal year ending June 30, 1896, the broken fender system about the head of the pier was repaired, at a total cost of $689.95.

The total expenditures to June 30, 1897, have been $378,500.

The right to use this pier for railway purposes, granted in the act of July 15, 1870, has never been exercised, and doubtless never will be, as the pier has not sufficient strength to support the weight of modern freight engines. It is therefore impossible to obtain any assistance from the railroad company in maintaining and repairing the structure.

The pier is of great use for the purposes of the engineer, light-house, and quarantine services. It is of very great value to vessels frequenting the breakwater harbor in winter, when the harbor is packed with floating ice, rendering the anchorage dangerous. At such times vessels eagerly seek its shelter and protection.

July 1, 1896, balance unexpended	$7,660.00
July 1, 1897, balance unexpended	7,660.00

(See Appendix G 5.)

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6. Delaware Breakwater, Delaware.—Under the act of Congress of May 7, 1822, $22,700 was appropriated for a survey of Delaware Bay near Cape Henlopen, for the purpose of determining upon the site for a harbor of shelter. In 1828 an appropriation of $250,000 was made for commencing the work under a plan submitted by a Board of Commissioners appointed by Congress.

The project of the Board contemplated the construction, in the concavity of the bay just inside Cape Henlopen, of two massive works on the pierres perdues or riprap system, separated by an interval or gap of 1,350 feet, the greater, called the breakwater, to afford safe anchorage during the gales from the north and east; the other, called the ice breaker, to protect shipping against northwesterly gales and the heavy drifting ice of the bay. This project was completed in 1869 under aggregate appropriations (including the first for survey) of $2,192,103.70. The stone used in the work amounted to 892,528 gross tons, and varied from one-fourth of a ton to 7 tons in weight, the smaller constituting the bulk of the mass, the larger used to cover the exterior slopes.

As completed in 1869 the breakwater is 2,558 feet long, and the ice breaker 1,359 feet long on top. The average width on top is 22 feet, and at base 160 feet. The top is from 12 to 14 feet above mean low water.

In 1882 a project was adopted for closing the gap between the breakwater and the ice breaker by means of a random stone foundation with a concrete superstructure. The random stone foundation was to be brought to a height of 12 feet below low water, with a width on top of 48 feet; the concrete superstructure to have a width on bottom of 24 feet, rising to a height of 12 feet above mean low water, with a width on top of 12 feet. The estimated cost of this project was $675,000.

In 1883 and 1884 the project was modified by providing a foundation of brush mattresses for the random stone substructure and omitting the construction of a pile bridge across the gap, which formed part of the project of 1882 for closing the gap.

In 1890 the concrete superstructure was further modified by establishing its base at 15 feet below low water, by making it rectangular in section, with a width of 27 feet and height of 27 feet, and by constructing the work to above the plane of high water of large concrete blocks, above which concrete in mass was to be used. The estimated cost of the modified project, including the $356,250 appropriated from 1882 to 1888, was $856,250.

In 1891, the random-stone substructure having been practically completed to an average level of 15 feet below low water, the project for the hitherto proposed concrete superstructure was modified by substitution of random stone for the remaining part of the work, so as to raise the structure to a height of 14 feet above mean low water, with a width on top of 20 feet, the width at low water to be 40 feet and the slopes below this plane to be such as may be formed by the action of the sea; between low water and the top the slopes to be about 1 on 0.7, formed by heavy stones laid in position. Owing to recent low prices, the work can be completed with funds now available, and no further appropriation is required.

From the beginning of the work in 1822 to June 30, 1896, the total amount expended was $2,699,988.21, of which $507,884.51 was expended on the existing project for closing the gap.

During the fiscal year ending June 30, 1896, the sum of $20,590.67 was expended in leveling the upper surface of the substructure and constructing a portion of the superstructure. During the past fiscal

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year the sum of $22,003.93 was expended in leveling and filling cavities in the substructure, completing the superstructure for a distance of 464 feet from the east end of the ice breaker, and partly constructing the superstructure for a further distance of 196 feet.

The Maritime Exchange of Philadelphia maintains a station on the breakwater, and through cables between the mainland and its station is in communication with the shipping of the harbor. Its reports state that during the year 1896 1,655 vessels, exclusive of tugs and fishing and small coasting craft, anchored under the protection of the breakwater.

July 1, 1896, balance unexpended		$108,365.49
June 30, 1897, amount expended during fiscal year		22,003.93
July 1, 1897, balance unexpended		86,361.56
July 1, 1897, outstanding liabilities	$22,242.18	
July 1, 1897, amount covered by uncompleted contracts	47,657.82	
		69,900.00
July 1, 1897, balance available		16,461.56

(See Appendix G 6.)

7. Harbor of refuge, Delaware Bay, Delaware.—The construction of this harbor was provided for on the continuing contract system by the river and harbor act of June 3, 1896, at a cost not to exceed $4,665,000. The act provides that in making the contracts the Secretary of War shall not obligate the Government to pay in any one fiscal year, beginning July 1, 1897, more than 25 per cent of the whole amount authorized to be expended.

No expenditures were made upon this improvement previous to June 30, 1896.

During the past fiscal year about 9,035 tons of stone was deposited for the formation of the projected breakwater. The work was commenced on May 4, 1897.

The low price provided for in the existing contract justifies a great reduction in the estimated cost of the work. It is now estimated that the total cost will not require further appropriation of more than $2,350,000 provided the annual appropriations are sufficient for rapid and economical progress.

The great value of this harbor to commerce is due to its location. It is about equidistant from New York, Philadelphia, and the capes of Chesapeake Bay (the ocean entrance to the ports of Baltimore, Norfolk, and Newport News), and is therefore an especially convenient point of call for the entire commerce of the North Atlantic Coast. It is now largely used by vessels awaiting orders to ports for discharge or loading, although the anchorage is exposed and dangerous except for small vessels which can find shelter in the old breakwater harbor. During the year ending December 31, 1896, 1,655 vessels (not including small craft) called at this locality. As an example of the value of the commerce, it may be mentioned as a single item that 233 of these vessels were laden with about 450,000 tons of sugar, valued at $32,000,000, the approximate value of the vessels being more than $8,000,000.

By the construction of the breakwater the usefulness of this anchorage will be greatly increased, not only as a port of call but also as a harbor of refuge. Vessels bound from Northern to Southern or from Southern to Northern ports will be able to go to sea in doubtful weather with the assurance of finding ample protection at the Delaware capes if overtaken by storms.

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July 1, 1896, balance unexpended		$5,000.00
Amount appropriated by sundry civil act approved June 4, 1897		394,334.00
		399,334.00
June 30, 1897, amount expended during fiscal year		2,394.02
July 1, 1897, balance unexpended		396,939.98
July 1, 1897, outstanding liabilities	$10,695.18	
July 1, 1897, amount covered by uncompleted contracts	386,244.80	
		396,939.98

Amount (estimated) required for completion of existing project	2,350,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	1,935,666.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix G 7.)

8. Rancocas River, New Jersey.—In its original condition Rancocas River carried a minimum low-water depth of 4½ feet between the mouth and Centerton, a distance of about 7½ miles, and from Centerton to Mount Holly, a distance of about 5½ miles, a ruling depth of about 2½ feet.

The original project of 1881 proposed the formation, by a dike at Coats Bar and dredging elsewhere, of a channel from 150 to 200 feet wide and 6 feet deep at mean low water from the mouth to Centerton, and thence to Mount Holly a channel 5 feet deep.

Operations under this project were carried on from 1881 to 1895. At the close of the fiscal year ending June 30, 1895, $37,500.21 had been expended in the formation of a low-water channel 100 feet wide and 6 feet deep from the mouth to Centerton, and 50 feet wide and 5 feet deep for a distance of about 1¾ miles above Centerton.

During the fiscal year ending June 30, 1896, no work was done.

One hundred dollars and nine cents appropriated for this work was carried to the surplus fund in 1890.

The appropriation of $2,000 for this river, made in the act of June 3, 1896, is required by the act to be expended in the improvement of the Lumberton Branch.

During the past fiscal year the Lumberton Branch was surveyed, and a project for its improvement by dredging a channel through the shoals which obstruct navigation was submitted on June 24, 1897, and approved July 1, 1897. The work can be completed with the funds now available.

The principal commercial interests are the manufacture of phosphorus and the transportation of sand and gravel. The total value of the freight movement for 1896 was $975,715. It is believed that the cost of improving this river will be more than is justified by the resulting commercial benefits.

July 1, 1896, balance unexpended	$2,399.70
June 30, 1897, amount expended during fiscal year	232.41
July 1, 1897, balance unexpended	2,167.29
July 1, 1897, balance remaining from appropriation of August 18, 1894, not available for expenditure under existing project	399.70
July 1, 1897, balance available	1,767.59

(See Appendix G 8.)

9. Alloway Creek, New Jersey.—In its original condition Alloway Creek was obstructed between its mouth and Quinton, a distance of about 10 miles, by shoal areas in the upper half of the stream which reduced the low-water depths to from 1.3 to 4 feet.

The original project of 1889 proposed the formation by dredging of

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a channel 6 feet deep at mean low water and 60 feet wide from Quinton to a point about 1,000 feet above the Upper Hancock Bridge; thence a channel of the same depth and 75 feet wide to a locality known as the Square, where the work is to be supplemented by a dike. At a locality known as the Canal, in addition to a channel of the last-named dimensions, the width of the stream was to be increased to about 150 feet between its low-water lines. The project was modified on December 10, 1896, so as to provide for a dike, formed by a single row of piles above the Upper Hancock Bridge. This modification does not increase the original estimated cost of the work, which is $25,000.

Up to the close of the fiscal year ending June 30, 1896, $11,998.72 had been expended in dredging at and near the Canal, the Square, and the Upper Hancock Bridge, and in dike construction at the Square. Channels from 40 to 75 feet wide and 6 feet deep at mean low water were formed through the worst bars.

During the past fiscal year 404 feet of dike was constructed.

The commerce of this creek consists of miscellaneous articles, such as coal, sand, lumber, and produce, and is principally of a local character. The value of the total freight movement for 1896 was $935,850. The improvement has been of much benefit to navigation, at a comparatively small cost.

July 1, 1896, balance unexpended	$3,001.28
June 30, 1897, amount expended during fiscal year	235.20
July 1, 1897, balance unexpended	2,766.08
July 1, 1897, amount covered by uncompleted contracts	2,766.08
Amount (estimated) required for completion of existing project	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix G 9.)

10. Dennis Creek, New Jersey.—This creek empties into Delaware Bay about 20 miles above Cape May. The head of navigation is at a bridge in the village of Dennis, about 9 miles from the mouth.

From deep water in Delaware Bay to the mouth of the creek there is a high-water depth of not less than 8 feet, with several feet more of liquid mud so diluted as to offer no perceptible resistance to the passage of vessels of 10 or 12 feet draft. From the mouth to a point 1½ miles below the bridge the channel has a high-water depth of about 12 feet, varying in width from 300 to 150 feet, with steep banks. For the remaining distance of 1½ miles to the bridge the channel has a bottom width of 60 to 70 feet and a width between banks of 80 to 100 feet up to the docks, where both the top and bottom widths are about 60 feet. The mid-channel depth at high water over this last reach of 1½ miles is about 5 feet. The range of tide is about 5 feet, so that over this reach the channel is bare at low water, except a channel 15 feet in width and 6 to 8 inches in depth formed by the backwater. The original depth of channel over this reach was about 7 feet, but about eight years ago a dam just above the bridge, formed to make a cranberry bog, broke away, carrying the material of the dam and the accumulated sediment back of it down in this reach, shoaling it to an average depth of 2 feet.

The project for this improvement (printed in Annual Report of the Chief of Engineers for 1895, p. 1105) provides for the formation, by dredging, of a channel 60 feet wide and 8 feet deep at mean high water from the Dennisville Bridge downstream for a distance of about 8,450 feet and the widening of the channel at the bends. It is proposed to cast the dredged material up on the banks or otherwise dispose of it so

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that it should not impair navigation. The quantity of material to be dredged is about 37,000 cubic yards, place measurement. The total cost of the improvement is estimated at $10,000.

At the close of the fiscal year ending June 30, 1896, no work had been done.

Expenditures during the past fiscal year were applied in removing a wreck and dredging 38,613 cubic yards of material, scow measurement, from the channel. By this work the entire improvement was completed.

The value of the freight moved on this creek in 1896, which was of a local character, is estimated at $50,800.

July 1, 1896, balance unexpended	$5,000.00
June 30, 1897, amount expended during fiscal year	4,701.05
July 1, 1897, balance unexpended	298.95

(See Appendix G 10.)

11. Cooper Creek, New Jersey.—This creek enters the Delaware River in the city of Camden, just above Cooper Point. It is navigable for a distance of 9 miles from its mouth for vessels drawing 5 feet, and for the first 5 miles for vessels of 11½ feet draft. The mean range of tide is about 6 feet. For a distance of 1½ miles from the mouth the width of the stream averages about 80 feet at low water and about 120 feet between the banks, and the channel has a depth of from 12 to 15 feet except at two places where the depths are 9½ and 13½ feet.

The project for this improvement is contained in a report dated January 2, 1895, which is printed in the Annual Report of the Chief of Engineers for 1895, page 1102.

It is proposed to dredge a channel 70 feet wide at bottom and 18 feet deep at mean high water from the mouth of the creek to Browning's Chemical Works, and a channel of the same dimensions through the bar just outside the mouth, in all a distance of about 9,000 feet. The proposed improvement requires the excavation of about 135,000 cubic yards of material, place measurement, and, including contingencies, is estimated to cost $35,000.

The river and harbor act of June 3, 1896, appropriated $37,000 for completing this improvement, of which $2,500, or so much thereof as might be necessary, was to be expended in rebuilding the dike on the Government reservation in the Delaware River at Woodbury Creek.

At the close of the fiscal year ending June 30, 1896, no work had been done.

During the past fiscal year the sum of $2,500 was expended in rebuilding the dike on the Government reservation at Woodbury Creek, and the sum of $389.94 was expended in the preliminary expenses of the work and in dredging material from the channel of the creek.

There are 9 large manufacturing plants on this creek, consisting of 1 woolen mill, 1 nickel works, 4 chemical works, 1 glass works, and 2 iron works. It is claimed that with an improved channel the most economical way of receiving materials and shipping products will be by schooners instead of by rail, as at present. The value of the total freight movement for 1891 was nearly $3,000,000.

July 1, 1896, balance unexpended		$37,000.00
June 30, 1897, amount expended during fiscal year		2,889.94
July 1, 1897, balance unexpended		34,110.06
July 1, 1897, outstanding liabilities	$7.53	
July 1, 1897, amount covered by uncompleted contracts	22,254.97	
		22,262.50
July 1, 1897, balance available		11,847.56

(See Appendix G 11.)

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12. Goshen Creek, New Jersey.—In its original condition Goshen Creek carried a low-water depth of from 2 to 4 feet, with a least low-water width of 20 feet and a high-water width of 36 feet from Goshen to a point about 4,000 feet below; and thence to the mouth, a distance of about 2,500 feet, a low-water depth of from 3 to 5 feet, with a least width of 30 feet.

The project for its improvement, adopted in 1891, proposed the deepening and widening by dredging of the 4,000 feet of the creek below Goshen Landing to a low-water depth of 3 feet and a width of 30 feet; the formation of a dredged channel, 3 feet deep and about 50 feet wide, through the bar at the mouth to the limit of the sand beyond the low-water line, and the protection of the channel by a sheet-pile jetty.

The improvement was commenced during the fiscal year ending June 30, 1893, and to the close of that year the sum of $2,770.16 was expended in widening and deepening the channel to the proposed dimensions over a distance of about 3,975 feet below Goshen Landing. By this work about one-fourth of the projected improvement had been completed and the navigable conditions had been proportionately improved.

The sum of $3,000 appropriated in the river and harbor act of August 18, 1894, was not sufficient to carry on the work in accordance with the project. It was therefore withheld until a further appropriation was made by Congress.

The total amount expended to the close of the fiscal year ending June 30, 1896, was $3,000.

During the past fiscal year the sum expended was for inspection and superintendence of the work of dike construction and for dredging.

The commerce of this creek consists of miscellaneous articles, such as sand, oysters, lime, coal, and lumber, and is principally of a local character. The value of the total freight movement for 1896 was $275,925. The improvement has been of much benefit at moderate cost.

July 1, 1896, balance unexpended	$6,000.00
June 30, 1897, amount expended during fiscal year	162.60
July 1, 1897, balance unexpended	5,837.40
July 1, 1897, outstanding liabilities	4,198.61
July 1, 1897, balance available	1,638.79
Amount (estimated) required for completion of existing project	3,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	3,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix G 12.)

13. Removing sunken vessels or craft obstructing or endangering navigation.—During the past fiscal year the following wrecks were removed under the provisions of the act of June 14, 1880: The schooner *Palestine* from Great Egg Harbor Inlet, New Jersey; the schooner *Alice Bell* from Great Egg Harbor Inlet, New Jersey, and the barge *Our Little Harry* from the channel of Delaware River opposite the eastern end of League Island. The amount expended in removal of wrecks during the past fiscal year was $1,403.58.

(See Appendix G 13.)

EXAMINATIONS AND SURVEY MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The preliminary examinations and survey of the following localities, required by the act of June 3, 1896, were made by the local engineer,

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Maj. C. W. Raymond, Corps of Engineers, and reports thereon submitted.

1. Preliminary examination of Barnegat Bay, New Jersey, between Mantoling (Mantoloking) and Bay Head.—Major Raymond submitted report of examination October 31, 1896. He is of the opinion that the waterway under examination is not worthy of improvement by the General Government; and the Chief of Engineers concurred in the view that, while the cost of the improvement desired would be small, the conditions are not such as to warrant the carrying out of such work at the expense of the United States. The report was transmitted to Congress and printed in House Doc. No. 115, Fifty-fourth Congress, second session. (See also Appendix G 14.)

2. Preliminary examination of Tuckerton Creek, New Jersey, and flats at mouth thereof.—Major Raymond submitted report of examination November 16, 1896. It is his opinion that this stream is worthy of improvement by the General Government, and the Chief of Engineers concurred with him to the extent of advising a survey, estimated to cost $400, upon the results of which a more reliable opinion can be formed as to the scope of the improvement justified by the interests of commerce involved. The report was transmitted to Congress and printed in House Doc. No. 123, Fifty-fourth Congress, second session. (See also Appendix G 15.)

3. Preliminary examination of Wading River, New Jersey.—Major Raymond submitted report of examination November 6, 1896. It is his opinion, concurred in by the Chief of Engineers, that Wading River is not worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 94, Fifty-fourth Congress, second session. (See also Appendix G 16.)

4. Preliminary examination of Beach Thoroughfare, New Jersey, at and near the meeting of tides from Absecon and Egg Harbor Inlet.—Major Raymond submitted report of examination October 28, 1896. It is his opinion, concurred in by the Chief of Engineers, that this waterway is worthy of improvement by the General Government. No survey will be necessary to the preparation of plan and estimate of cost of work proposed. The report was transmitted to Congress and printed in House Doc. No. 51, Fifty-fourth Congress, second session. (See also Appendix G 17.)

5. Preliminary examination of Oldmans Creek, New Jersey.—Major Raymond submitted report of examination November 16, 1896. He states that in his judgment this stream is worthy of improvement by the General Government, and the Chief of Engineers concurred in this opinion to the extent of advising a survey, estimated to cost $500, upon the results of which a more reliable opinion can be formed as to the scope of the improvement justified by the commerce involved. The report was transmitted to Congress and printed in House Doc. No. 120, Fifty-fourth Congress, second session. (See also Appendix G 18.)

6. Preliminary examination of Dividing Creek, New Jersey.—Major Raymond submitted report of examination November 7, 1896. It is his opinion that this stream is worthy of improvement by the General Government. The Chief of Engineers concurred in the views of the district officer to the extent of advising a survey, estimated to cost $150, upon the results of which a more reliable opinion can be formed as to the scope of the improvement justified by the commerce involved. The report was transmitted to Congress and printed in House Doc. No. 93, Fifty-fourth Congress, second session. (See also Appendix G 19.)

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7. Survey of Salem River from its mouth to Salem City, N. J.—Major Raymond submitted report of survey June 29, 1897. The project of improvement presented provides for the formation, by dredging, of a channel 100 feet wide and 9 feet deep at mean low water, amplifying at the bends so as to permit the passage of vessels 200 feet long from the Delaware River up to the highway bridge over Little Salem Creek, including the removal of the stony bars in front of the city wharves and at the bend above the brickyard. The cost of the work proposed is estimated at $31,500. The report was transmitted to Congress and printed in House Doc. No. 78, Fifty-fifth Congress, first session. (See also Appendix G 20.)

IMPROVEMENT OF RIVERS AND HARBORS IN DELAWARE, IN MARYLAND, EAST OF CHESAPEAKE BAY, AND OF INLAND WATERWAY FROM CHINCOTEAGUE BAY TO DELAWARE BAY, VIRGINIA, MARYLAND, AND DELAWARE.

This district was in the charge of W. F. Smith, United States agent, major of Engineers, United States Army, retired. Division Engineer, Col. Peter C. Hains, Corps of Engineers.

1. Wilmington Harbor, Delaware.—Previous to 1836, when the first appropriation for the improvement of the Christiana River was made, the depth of water at the entrance was about 8½ feet. The minimum depth in the channel of the portion of the river below Third Street Bridge was 8 feet. This depth was increased by dredging in that year to 10 feet.

Under a project commenced in 1871 and completed in 1881, a 12-foot channel from 100 to 200 feet wide was made from the mouth to above the city of Wilmington. In 1881 a project was adopted for a 15-foot low-water channel from the mouth of the river to the pulp works, with a width of 150 feet from the mouth to the Rolling Mill Wharf, 100 feet to the Delaware and Western Railroad Bridge, and 75 feet to the pulp works. This project included, further, a channel 12 feet deep and 50 feet wide from the latter works to the Delaware Railroad Bridge and construction of a jetty on the north side of the mouth of the river. Operations under the project were begun in the following year. The original estimate was $175,551, which was increased in 1883 to $191,384 by changing the width of the proposed channel to 150 feet throughout. In 1884 the project was amended by raising the height of the jetty 4 feet. The channel was made 150 feet wide and 15 feet deep at mean low water by dredging and rock removal, from the 15-foot depth outside the bar at the mouth to a point 2,515 feet above Market Street Bridge, 80 feet wide thence for a distance of 820 feet, and thence 40 feet wide to the pulp works. This was the work done to 1893.

At the close of the fiscal year 1896 work was in progress under a contract made the preceding year for redredging the channel where it had shoaled, and the channel had been redredged to a depth of 13 feet at mean low water from the 13-foot contour at the mouth of the Christiana River to a point about 1,000 feet above the mouth of the Brandywine Creek. This work was closed September 17, 1896.

The amount expended for the improvement of the harbor to June 30, 1896, is $366,027.21, of which $250,171.21 was expended on the project of 1881 and its modifications.

The river and harbor act of June 3, 1896, appropriated $5,000, to be used in the discretion of the Secretary of War, for improving the channel between Churchman's bridge and Smalley's bridge.

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A contract was made for the work and operations were begun on October 21 at Churchman's bridge and continued until the end of the year, when the contract was closed. There was then a continuous channel with a least depth of 3 feet at mean low water and a width of 25 feet for a distance of 3.35 miles from Churchman's bridge toward the bridge at Christiana village and a similar channel for a distance of 4,033 feet above that bridge toward Smalley's bridge. The work done has improved navigation in this part of the river and has increased the range of tide about 1 foot as far up as the wharf of the Delaware Glass, Sand, and Clay Company.

The river and harbor act of June 3, 1896, provided $15,000 for continuing the improvement of Wilmington Harbor "in accordance with the modified project," and also authorized the making of contracts to complete the project of improvement at a cost not to exceed $225,846.

The project referred to is understood to be the project for a 21-foot channel, report upon which will be found in the Annual Report of the Chief of Engineers for 1896, pages 973–994.

As it was doubtful whether the project could be carried out under the conditions of the law authorizing a contract, a Board of Engineer Officers was convened by the Chief of Engineers to consider and report upon the plan of improvement.

The report of the Board is given in Appendix H 1 of this report.

The Board expresses the opinion that the existing project can not be successfully carried out and recommends a modified project, including the construction of a jetty on the south side of the entrance to the river, the rectification of the channel of the Christiana River at the mouth of the Brandywine, and necessary dredging to give a channel of 21 feet at mean low water from the mouth to the upper line of the pulp works. The estimated cost is $377,542. It is stated that the proposed channel is of greater dimensions than the river can naturally maintain and that annual dredging will be necessary. The United States agent in local charge of this work estimates that certain rock work not included in above estimate will increase the cost of work $99,000.

Under a project for the expenditure of the available funds in conformity with a recommendation of the Board, a contract for dredging was executed, and work thereunder began on June 24, 1897, at a point opposite the Atlantic Refining Company's wharf, where operations closed under the previous contract. At the close of the fiscal year 5,676 cubic yards of material had been removed and the channel dredged to a width of 150 feet for a length of 385 feet, and for a further length of 400 feet to a width of 100 feet, in both cases to a depth of 15 feet at mean low water. No contract for work in excess of appropriations made has been entered into for this improvement, and before such contract is made it is desirable that Congress authorize a modification of project as recommended by the Board, and that the limiting cost be increased.

The appropriations for the harbor for the past four years, after deducting the $5,000 for improvements at Churchman's bridge and the survey called for by the river and harbor act of August 18, 1894, have averaged between $8,000 and $9,000 a year, while the shoaling is estimated at the rate of 100,000 cubic yards a year, and possibly much more. Strong efforts have been made in the direction of protecting the channel, by calling the attention of the local authorities to the matter of sewage deposits, with the view of keeping them down as far as possible, and by information to the United States district attorney of

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violations of the laws of Congress made for the protection and preservation of navigable waters. The flushing basin to which the Board of Officers of 1896 calls attention is maintained by the city, and not by the Pusey & Jones Company, as erroneously reported. Since the matter has been agitated it is understood that the city has appropriated $2,000 for the removal of deposits. It may safely be assumed that between $20,000 and $25,000 is needed annually for the maintenance of the 15-foot channel.

The important commercial interests of this city warrant liberal expenditures in making and maintaining a proper channel.

July 1, 1896, balance unexpended		$36,167.57
June 30, 1897, amount expended during fiscal year		12,174.63
July 1, 1897, balance unexpended		23,992.94
July 1, 1897, outstanding liabilities	$950.00	
July 1, 1897, amount covered by uncompleted contracts	23,000.00	
		23,950.00
July 1, 1897, balance available		42.94

Amount (estimated) required for completion of existing project	476,625.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	205,846.00
Amount required for maintenance in fiscal year ending June 30, 1899	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix H 1.)

2. Nanticoke River, Delaware and Maryland.—This river is a tidal stream, its head waters consisting of numerous branches rising mainly in the northern section of Sussex County, Del. The river flows in a south-southwesterly direction into Tangier Sound, Chesapeake Bay, and the interests for the improvement of the river center at Seaford, 36 miles from the mouth.

The river and harbor act of August 18, 1894, appropriated $5,000 for improving Broad Creek River, Delaware, and provided that as much of it as might be necessary should be used for the removal of the bar extending from the railroad bridge at Seaford toward the mouth of the Nanticoke River. With this appropriation the channel was dredged, where necessary, to a width of 100 feet and a depth of 9 feet at mean low water, from the south side of the railroad bridge at Seaford to a point 8,000 feet below. A previous appropriation for the Nanticoke River, in 1886, was, in accordance with the terms of the law, applied to the stream known as Broad Creek River, a branch of the Nanticoke River extending to Laurel.

The project for the improvement of the Nanticoke River is based upon a survey made in 1895, and is for a channel 9 feet deep at mean low water and 100 feet wide, the width to be increased to about 150 feet at sharp turns of the channel, the improvements to be extended to within 100 feet of the county bridge, where the proposed channel is to widen out fan shape, at an estimated cost of $13,000.

The act of June 3, 1896, contains the first appropriation ($3,000) for this river, and a contract has been made for work under the approved project. No operations were in progress during the fiscal year. The expenditures in the year were for office expenses.

The commerce for the year 1896 is reported to be, receipts and shipments, 17,049 tons at a valuation of $684,105.

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July 1, 1896, balance unexpended	$3,000.00
June 30, 1897, amount expended during fiscal year	59.12
	2,940.88
July 1, 1897, amount covered by uncompleted contracts	2,940.88

Amount (estimated) required for completion of existing project	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	3,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix H 2.)

3. Appoquinimink River, Delaware.—At the time of the adoption of the present project there was a mean low-water depth of 2 feet at the entrance into Delaware Bay, and the shoalest depth inside the river was 4½ feet. The most serious obstructions to the navigation of the river were the many bends in the lower and middle sections.

The approved project is based upon a survey made in 1889, and is for a channel 8 feet deep at mean low water, having a width of 80 feet from the bridge at Odessa to near Townsend's wharf, a distance of 3¼ miles, and a width of 100 feet from this wharf to the mouth of the river, a distance of 5 miles. The estimated cost of the improvement is $39,963.

In 1891 the channel was dredged to the full width of 80 feet and depth of 8 feet at mean low water for a distance of 1,975 feet in a down-river direction, beginning at the lower end of Watkins's wharf, at Odessa, and early in 1893 a further distance of 4,487 feet was dredged. Of the latter, 595 feet was dredged to the approved width, but on account of the settlement and sliding in of the very soft marsh banks upon which the excavated mud and sand were deposited the full approved width of 80 feet could not be made along the remainder, 3,892 feet, and it was therefore made only 50 feet until the banks should become firmer. The entire length dredged is 6,462 feet, of which 2,570 feet is 80 feet wide and 3,892 feet is 50 feet wide. The channel was thereby materially improved as far as the work had progressed, giving great relief to the shipping, and the harbor room at Odessa increased. The amount expended on this improvement to the close of the fiscal year 1896 was $10,152.73. No work has been done since 1893. The expenditures during the year were for office expenses.

At the beginning of the fiscal year a contract, dated May 23, 1895, was in force for dredging on this and other rivers in Delaware, the work on all of them to be completed by September 1, 1896. Owing, however, to the tardiness of the contractor in the performance of the work on the Smyrna River, one of the improvements provided for, the contract was annulled on July 27, 1896, before the Appoquinimink work was reached.

The river and harbor act of June 3, 1896, made a further appropriation of $5,000 for this improvement, and a new contract for dredging has been entered into.

The work proposed to be done is the dredging of the channel to a depth of 8 feet at mean low water and a width of 50 feet in straight reaches and widening in the bends through various shoals between a point 6,400 feet below Odessa, where work was last suspended, and the mouth of the river; to widen the cut-off below New Bridge, to dredge off several projecting points, and to redredge shoaling in the upper river as far as available funds will permit. It was intended to include in this work the making of the proposed cut-off at New Bridge and one below, but it was impracticable to procure the title to the land required for the purpose. The difficulties in the way may possibly be overcome before further improvements are made on the river.

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The commerce in the river is reported for the past year to have been 20,170 tonnage and a valuation of $961,250, as against 19,132 tons and $980,975 in 1891, shortly after the improvement of the river was begun. The extent of the commerce justifies the outlay for the proposed improvement.

July 1, 1896, balance unexpended	$9,847.27
June 30, 1897, amount expended during fiscal year	736.25
July 1, 1897, balance unexpended	9,111.02
July 1, 1897, amount covered by uncompleted contracts	9,111.02
Amount (estimated) required for completion of existing project	19,963.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix H 3.)

4. Smyrna River, Delaware.—This river, formerly called Duck Creek, had, before improvements were begun in 1879, a minimum depth of 2½ feet within the river and about 4 feet over the bar at the mouth. Navigation was possible only at high tide, and was carried on by one steamer and seven small schooners.

In 1878 a project was made for the improvement of the whole river, including a plan for deepening the channel across the bar at the mouth.

By special direction of Congress the improvement of the bar was commenced first, and during the following four years three appropriations, aggregating $10,000, were expended in dredging a channel across this obstruction 100 feet wide and 8 feet deep at mean low water. The dredged channel soon filled up again.

A new project was submitted in 1887 for a 7-foot low-water channel 60 feet wide inside the river and 100 feet at the bar, the channel at the latter point to be protected by a stone jetty. The estimated cost of this project is $91,698.40. The first appropriation under the project, that made in 1888, was for dredging, and the appropriations made since have provided for continuing the improvement and have likewise been applied solely to dredging. The estimated cost of the dredging was $37,365.20, and that for the jetty was $53,733.20.

In 1893 the channel was dredged to the approved dimensions for a length of 4,730 feet, in seven different localities between Smyrna Landing and Gravel Reach, about 5 miles below. Dredging had been done there previously, but not to the full dimensions. Also a cut 50 feet wide and 7 feet deep through a narrow bar about a half mile inside the mouth of the river. In 1896, to June 30, the turning basin at Smyrna Landing was redredged to the full dimensions, and the channel below dredged to the full width and depth at Price's wharf, Limekiln Wharf, Beaverhouse Reach, the reach above and below Rothwells Landing and below the "Canal."

The total amount expended on this improvement to June 30, 1896, was $29,338.82, of which $19,338.82 was expended on this project.

At the beginning of the fiscal year 1897 dredging operations were in progress under contract, but, owing to a failure of the contractor to comply with the terms of the contract, it was annulled July 27, 1897.

A new contract was made and work thereon was begun September 1 and completed October 14, 1896. During this period the channel was dredged at six different parts of the river between Smyrna Landing and Cave Landing Reach, a distance of 20,400 feet, resulting in a channel of the approved depth for that length, the width varying between 40 and 60 feet. This left about one-third of the project to be done. As

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this work was not completed until late in the fall, it was deemed best to wait until the spring for the expenditure of the $5,000 appropriated by the river and harbor act of June 3, 1896, for continuing the improvement, as the work could then be contracted for and done to better advantage to the Government. On June 15, 1897, a contract was made for dredging a channel to a depth of 7 feet at mean low water and a width of 60 feet from near Cave Landing, where work was last suspended, toward the mouth of the river, and to redredge shoals and remove some projecting points in the upper river, and it is expected that this will be completed this fall.

The commerce in the river is reported for the past year to have been 304,146 tons, and of a valuation of $3,034,280. In 1889, before the improvements were begun, the tonnage and valuation were reported to be 204,706 and $1,944,000, respectively. The extent of the commerce justifies the outlay for the improvement.

July 1, 1896, balance unexpended	$8,661.18
June 30, 1897, amount expended during fiscal year	3,624.28
July 1, 1897, balance unexpended	5,036.90
July 1, 1897, amount covered by uncompleted contracts	5,000.00
July 1, 1897, balance available	36.90
Amount (estimated) required for completion of existing project	9,365.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	9,365.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix H 4.)

5. Murderkill River, Delaware.—This river is a tidal stream and a tributary of Delaware Bay, and flows through Kent County, Del. Its navigable portion is about 9 miles long. The condition of the river was fair for the greater part of its length, the average width and depth being 90 and 6 feet, respectively. Outside the junction with Delaware Bay, however, there is a serious obstruction—the flats, which are nearly bare at low tide and extend for nearly a mile from the shore. The average rise and fall of the tide at the mouth is 4.6 feet.

In 1881 an examination of this river was made, and a project submitted for its improvement. No appropriation was made by Congress, however, as the river was at that time in the hands of an improvement and navigation company chartered by the State. This company had expended about $10,000 in rectifying the many bends of the river by cutting straight canals and in dredging a narrow cut across the flats at the mouth. The latter slowly filled up again.

The project for improvement adopted in 1892 is for a 7-foot low-water channel 80 feet wide from the town of Frederica, at the head of navigation, to the mouth of the river, and 150 feet wide from the mouth across the flats outside to the 7-foot depth in Delaware Bay, the cut at the mouth to be protected by forming an embankment of the dredged material on each side, the estimated cost being $47,550.

In 1893 a channel was dug to a depth of 5 feet below mean low water across the flats from a short distance inside the river to the 5-foot depth in Delaware Bay, and in 1895 a cut-off 975 feet long was made at Lower Landing, about 4 miles from the mouth, and shoals were dredged at a sharp turn in the river below Frederica, at the head of Long Canal, at Coles Shoal, and just inside the mouth of the river. The width of the cut in every case was 40 feet and the depth 7 feet at mean low water.

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The amount expended on the project to the end of the fiscal year 1896 was $11,354.21.[1]

The river and harbor act of June 3, 1896, appropriated $6,500 for continuing the improvement. A contract dated November 13, 1896, was made for dredging, and work thereunder began on November 18, 1896, and closed June 19, 1897.

The quantity of material dredged was 24,425 cubic yards, and the result of the work done is an unobstructed low-water navigation of 6 feet depth from that depth in Delaware Bay to Lindells Shoal, a distance of 16,000 feet.

The commerce of this river, which is quite varied, is reported for the past year to be represented by a tonnage of 40,642 and a valuation of $925,362.50. There appears to have been quite an increase since the improvements were begun, and a steamboat line has in consequence of this improvement been established between Frederica and Philadelphia.

July 1, 1896, balance unexpended	$7,145.79
June 30, 1897, amount expended during fiscal year	6,974.47
July 1, 1897, balance unexpended	171.32
Amount (estimated) required for completion of existing project	32,764.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix H 5.)

6. Mispillion River, Delaware.—This river is a tidal stream, and enters Delaware Bay about 17 miles northwest of Cape Henlopen. It is navigable for about 12 miles. The mouth of the river is greatly obstructed by a flat foreshore without a channel. Vessels can enter and depart only at high water, which rises, on an average, 4 feet.

The river from Milford to the mouth was improved by the General Government between the years 1879 and 1889, and $17,000 was expended in making a channel 40 feet wide and 6 feet deep at mean low water.

The project for the improvement at the mouth of the river, proposed in a report on a survey made in 1891, provides for a cut across the flats in a southeasterly direction, having a width of 150 feet and a depth of 6 feet at mean low water, beginning opposite the light-house and ending in deep water in the bay, the cut to be protected on the upper or north side by a bank made of the excavated material. The estimated cost is $24,000.

In 1893 operations were begun under the project, and at the close of work in that season a pile dike 500 feet long had been built on the north side of the mouth, along the line of the channel, and a channel had been dredged for a length of 570 feet, 80 feet wide and 5 feet deep at mean low water, extending from the 5-foot depth in the Mispillion River to a point opposite and 50 feet west from the outer end of the dike, and in 1895 and 1896 a channel was dredged 75 feet wide and 6 feet deep at mean low water from inside the river just above Sandy Point to opposite the mouth of Cedar Creek, and a crib dike 350 feet in length, flanking the new channel on the west side, was built. The dikes were found necessary during the progress of the dredging owing to the character of the material dredged, which was mainly treacherous sand. The total amount expended on this improvement to June 30,

[1] Of this amount $1,500 was expended in removing shoal at mouth of St. Jones River.

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1896, was $34,507.39, of which $17,507.39 was expended on the present project. No work has been done during the past fiscal year. Expenditures during the year were for office expenses.

To meet present difficulties of navigation it has been concluded to expend the small balance available in dredging a channel, 100 feet wide and 6 feet deep at mean low water, from the end of the western jetty in a southerly direction to the old channel, and in the construction of a brush and stone dike to extend from the end of the present pile dike along the line of the channel. The small balance will build about 200 feet of the dike. This will be of some service as far as it goes.

Contracts have been made for the dredging and for the dike construction, and it is expected that the work on both contracts will be completed this season.

The commerce of this river consists principally of lumber, railroad ties, grain, canned goods, lime, and fertilizers, and is reported for the past year to have been 55,776 tons, and of a valuation of $850,599. In 1891, when the project was adopted, shipments and valuation were reported to be 44,315 tons and $916,250, respectively. It is not likely that the commerce will be benefited to any extent by the improvements until such work is carried out as will give and maintain a depth of 6 feet.

It is estimated that $500 will be required for maintenance of the improvement during the fiscal year ending June 30, 1899.

July 1, 1896, balance unexpended	$4,492.61
July 30, 1897, amount expended during fiscal year	122.28
July 1, 1897, balance unexpended	4,370.33
July 1, 1897, amount covered by uncompleted contracts	4,370.33
Amount (estimated) required for completion of existing project	2,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	2,000.00
Amount required for maintenance in fiscal year ending June 30, 1899	500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix H 6.)

7. Broadkiln River, Delaware.—In its original condition the depth of water in the river was from 3 to 4 feet at the numerous shoals which impeded navigation. The depth at the entrance was and still is from 1½ to 2 feet at low water.

The original project for improvement, made in 1871, is for a 6-foot low-water navigation, with a minimum width of 40 feet from the mouth of the river to Milton, the head of navigation, and for a new entrance, protected by a jetty, at an estimated cost of $80,447. This project was modified in 1881 relative to the entrance, and the estimate reduced to $51,450. The channel within the river has been completed in accordance with the project at an expense of $35,000, which was the total amount expended at the close of the fiscal year ending June 30, 1896. After entering, vessels are no longer detained by the shoals at low tide and proceed directly to their destination.

No work was done during the past year.

Amount (estimated) required for completion of existing project	$21,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix H 7.)

8. Inland waterway from Chincoteague Bay, Virginia, to Delaware Bay at or near Lewes, Del.—The original project, based on a survey made in 1884, provided for a channel 70 feet wide at the bottom and 6

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feet deep below mean low water in the Delaware Breakwater Harbor connecting the inland bays between Chincoteague Bay and Delaware Bay, the northern outlet to be at or near Lewes, Del. The length of the proposed waterway is about 75 miles, and the cost was estimated at $350,000. This project was modified in 1892, the width of the proposed channel having been reduced to 20 feet at the bottom.

At the close of the fiscal year ending June 30, 1896, $165,971.04 had been expended on the work.

The condition of the work done on the inland waterway was at the close of the fiscal year ending June 30, 1896, as follows: The cut made between Whites Creek and the head of Little Assawaman Bay to a depth of 4 feet had shoaled considerably, at the northern end to eight-tenths of a foot and in the middle portion to 2 feet. The first-named shoal is in the deepest portion of the cut where the sandy side slopes, bare of all vegetation, fall in considerably during heavy rains. The depths in the cut through low or marshy ground had maintained themselves very well. The cut made to a depth of 6 feet from Rehoboth Bay along Millers Creek toward the high ground back of Rehoboth, during the working season of 1894, was in fair condition except the formation of a slight shoal in line with the bay shore, which was evidently caused by wave action.

The only work done during the year was the repair of one of the bridges, and the making up of field notes, plotting progress charts, etc., of work done in the previous year.

The river and harbor act of June 3, 1896, appropriated $25,000 for continuing this improvement, but until certain litigation regarding right of way is settled it is not likely that any dredging work can be done.

July 1, 1896, balance unexpended	$27,778.96
June 30, 1897, amount expended during fiscal year	726.66
July 1, 1897, balance unexpended	27,052.30
Amount (estimated) required for completion of existing project	156,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix H 8.)

9. Susquehanna River above and below Havre de Grace, Md.—Before improvements were begun in this section of the river the least depth of water over the shoals between Havre de Grace and Spesutia Island was 5 feet at low water. The channel above Havre de Grace between Watson Island and the shoal running out from the west shore was narrow, and believed to be one of the causes of ice gorges at and near Port Deposit.

Improvements have been in progress since 1852. The present general project is for a 15-foot low-water channel below Havre de Grace and for the removal of the shoal opposite Watson Island to a depth of 8 feet below mean low water. Estimated cost, $168,000.

The channel below Havre de Grace was dredged the last time in 1885. It has shoaled again. The channel at Watson Island has been widened about 400 feet, but the shoal which was removed has nearly entirely reformed since the discontinuance of work in 1889.

Up to the close of the fiscal year ending June 30, 1896, $161,067.37 had been expended on this section of the river, including $49,729.15 for work for the Fish Commission.

There were no operations during the fiscal year ending June 30, 1897,

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the small amount available being limited to expenditure above the Philadelphia, Wilmington and Baltimore Railroad Bridge, and regarded insufficient to bring about results permanent enough to justify its expenditure. It was impracticable to obtain complete commercial statistics. It is estimated that $20,000 will be required annually for dredging.

July 1, 1896, balance unexpended	$9,822.63
July 1, 1897, balance unexpended	9,822.63
Amount (estimated) required for annual dredging. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	20,000.00

(See Appendix H 9.)

10. Chester River, Maryland, from Crumpton to Jones Landing.—This river is a tidal stream 40 miles long, forming the boundary line between Kent and Queen Anne counties, eastern shore of Maryland, and flows into Chesapeake Bay. It is navigable for vessels drawing 6 feet of water at low tide as far as Crumpton, about 33 miles above the mouth. The least depth of water within the last 7 miles of the river is 3 feet. At Crumpton the average rise of the tide is 2.1 feet. A short distance from this town several shoals have previously been improved by the United States.

The project for improvement is for a 6-foot low-water channel 60 feet wide from Crumpton to Jones Landing, a distance of 6¼ miles, at an estimated cost of $12,750.

Up to the close of the fiscal year ending June 30, 1896, $9,328.40 had been expended and the channel had been improved at various points in accordance with the project.

No work has been done during the past fiscal year. Expenditures during the year were for office expenses.

The river and harbor act of June 3, 1896, appropriated $1,500 for continuing the improvement, and a contract has been made for the work to be done.

The commerce of the river consists mainly of agricultural products. No complete statistics have been obtained, but the Chester River Line reports it business for the year on the whole river as 36,113 tons, valued at $1,152,101. There is no marked improvement in the commerce to be noted, but the improvements made in the river thus far have facilitated navigation, the extent of which seems to justify the expenditure.

July 1, 1896, balance unexpended	$1,671.60
June 30, 1897, amount expended during fiscal year	152.50
July 1, 1897, balance unexpended	1,519.10
July 1, 1897, amount covered by uncompleted contracts	1,500.00
July 1, 1897, balance available	19.10
Amount (estimated) required for completion of existing project	3,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	1,750.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix H 10.)

11. Choptank River, Maryland.—Before improvements were begun, in 1879, the depth of water in the channel between Denton and Greensboro varied from 2 to 8 feet at low water. Navigation carried on by small sailing vessels extended only to 3 miles above Denton. Upon the

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remaining 5 miles to Greensboro all freight had to be transported upon scows.

A project for improvement was made in 1880 for an 8-foot low-water channel 75 feet wide, the estimated cost being $79,000. Up to the close of the fiscal year ending June 30, 1896, $49,866.60 had been expended in making a channel not less than 75 feet wide and 7½ feet deep between Greensboro and Brick Mills, a distance of about 4 miles, and to a width of 75 feet and a depth of 8 feet for a further distance of 1,800 feet below the Brick Mills. The remaining distance to Denton has been partly improved by dredging the channel where needed to depths of 5 and 6 feet, and by widening it to about 40 feet. This leaves somewhat less than 4 miles of this section and several points in the upper river to be dredged to the approved dimensions. Shortly after the main obstructions had been removed in 1887, steamboat communication with Baltimore was established, and since that time commerce has steadily increased. No work has been done during the past fiscal year. Expenditures during the year were for office expenses.

The commerce consists largely of agricultural products and canned goods. The tonnage reported for 1896 is 17,193 tons, with a valuation of $647,893. There has been a marked increase in the commerce of this river since its improvement was begun, and its extent fully justifies the expense of making it.

The river and harbor act of June 3, 1896, appropriated $2,000 for continuing the improvement, and a contract for dredging has been entered into.

July 1, 1896, balance unexpended	$2,133.40
June 30, 1897, amount expended during fiscal year	293.03
July 1, 1897, balance unexpended	1,840.37
July 1, 1897, amount covered by uncompleted contracts	1,840.37
Amount (estimated) required for completion of existing project	16,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix H 11.)

12. La Trappe River, Maryland.—This river, formerly called Dividing Creek, is in Talbot County, eastern shore of Maryland, and flows into the Choptank River, one of the larger tributaries of Chesapeake Bay. It is about 3 miles long and has no fresh-water inflow at the head, and was originally only 4 feet deep. The entrance to the river was seriously obstructed by several shoal bars, with a least depth of 9 feet in the narrow channel, which was very tortuous and about one-half of a mile long. The average rise of tide is 1.55 feet.

Previous to the adoption of the present project the sum of $5,333.50, raised by private subscription, had been expended in dredging at the head of the river and at the bar at the mouth. The average depth in the river was thereby increased to 8 feet, and the channel at the mouth was somewhat widened.

The present project for improvement provides for a channel 150 feet wide and 11 feet deep across the bar at the mouth, and for a channel 75 feet wide and 8 feet deep at mean low water inside the river as far as Trappe Landing, situated at the head of navigation, and a turning basin at the latter point. The estimated cost was $7,250.

Up to the close of the fiscal year ending June 30, 1896, $7,213.87 had

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been expended, and the proposed channel within the river had been completed. The proposed channel at the mouth, about 1,600 feet long, had been dredged to the approved width of 150 feet for a distance of 400 feet, and to a width of 100 feet only for the remaining 1,200 feet. No work has been done during the past fiscal year. The channel in this 1,200 feet, therefore, remains to be widened 50 feet in order to conform to the approved project, and it is estimated that to complete it $2,500 will be required in addition to the amount already expended and originally estimated as the cost of the whole improvement.

In 1893, when the improvements of this river begun, the tonnage was 29,094 tons and the valuation $897,450, as compared with 20,628 tons and $704,950 in 1895. No statistics have been obtained for 1896. The improvements made thus far have facilitated commerce, but have not increased it.

July 1, 1896, balance unexpended	$36.13
July 1, 1897, balance unexpended	36.13
Amount (estimated) required for completion of existing project	2,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	2,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix H 12.)

13. Warwick River, Maryland.—This river, formerly named Secretary Creek, is in Dorchester County, eastern shore of Maryland, and flows into the Choptank River, one of the larger tributaries of Chesapeake Bay. It is a small tidal basin 2 miles long, with no fresh-water influx at the head, and was originally only 4 feet deep. The average rise of the tide is 1.7 feet.

Before the adoption of the present project about $12,000 had been expended in the improvement of this river, $6,000 by the General Government and the remaining amount by private parties. The present project for improvement, which was proposed in a report on a survey in 1891, provides for a channel 100 feet wide and 10 feet deep at mean low water from the 10-foot depth in Choptank River to Secretary Landing, at the head of the river, including a turning basin at the latter point, at an estimated cost of $18,600.

At the close of the fiscal year ending June 30, 1896, $13,918.82 had been expended for the improvement of this river, of which $7,918.82 was on the present project.

The turning basin at Secretary Landing had been completed, and the channel of the approved dimensions dredged from outside the mouth of the river for a length of 4,400 feet. There was then no serious obstruction to navigation in the river, and what remained to be done to complete the project was the widening of the channel in the upper river to the approved width of 100 feet for about one-third of its total length. No work has been done in the past fiscal year.

The commerce of the river consists mainly of agricultural products. The business of the steamboat line for the year is reported to be 3,617 tons, at a valuation of $140,937. The business done in the river by the numerous sailing vessels could not be obtained. It is believed there has been no material change since the improvements were begun in 1892, but the work has facilitated navigation, the extent of which seems to justify the outlay.

The river and harbor act of June 3, 1896, appropriated $2,000 for continuing the improvement, and a contract has been made for the work to be done.

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July 1, 1896, balance unexpended	$2,081.18
July 1, 1897, balance unexpended	2,081.18
July 1, 1897, amount covered by uncompleted contracts	2 000.00
July 1, 1897, balance available	81.18
Amount (estimated) required for completion of existing project	8,600.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	6,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix H 13.)

14. Broad Creek River, Delaware.—This river is a tidal stream and a tributary of the east fork of the Nanticoke River, which flows into the Chesapeake Bay.

Before improvements were commenced in 1881 the low-water depth at Laurel was 2 feet; below the town it was in some places only 1½ feet. At the close of the fiscal year 1889, when the original project was completed, at a cost of $35,000, a channel 6 feet deep at mean low water and 50 feet wide had been dredged from Bethel to Laurel, a distance of nearly 3 miles, and contributed toward making Laurel an important shipping point on the peninsula.

The project for improvement proposed in a report upon an examination made to comply with the requirements of the river and harbor act approved September 19, 1890, provides for dredging a channel 70 feet wide and 8 feet deep at mean low water from Bethel to the head of navigation at Laurel, at an estimated cost of $15,000.

The amount expended on the improvement to the close of the fiscal year 1896 was $9,899.36,[1] exclusive of the $35,000 expended before the adoption of the present project. At that date a channel of the approved dimensions, 70 feet wide and 8 feet deep at mean low water, had been dredged for a distance of 6,455 feet, beginning at a point 1,000 feet above the bridge at Bethel and ending 680 feet above Hitch's upper wharf, and an additional cut, also 8 feet deep, but only 40 feet wide, was dredged for a length of 215 feet across a shoal situated just beyond the section of the channel that had been dredged to the full width. This was accomplished in 1893, and no work under the project has been done since.

The river and harbor act of 1894 appropriated $5,000 for continuing this improvement, which was expended for the removal of the bar that extended from the railroad bridge at Seaford toward the mouth of Nanticoke River.

It has been impracticable to obtain complete commercial statistics. The extent of the known commerce on the river, however, justifies the outlay for the improvement.

The river and harbor act of June 3, 1896, appropriated $5,000 for continuing the improvement, and the work to be done has been contracted for.

July 1, 1896, balance unexpended	$5,100.64
June 30, 1897, amount expended during fiscal year	169.90
July 1, 1897, balance unexpended	4,930.74
July 1, 1897, amount covered by uncompleted contracts	4,930.74
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix H 14.)

[1] Of this amount $4,899.51 was expended in fiscal year 1896 in removing bar on Nanticoke River under the terms of the act of August 18, 1894.

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15. Wicomico River, Maryland.—The portion of the river at and just below Salisbury has been under improvement by the United States since 1872. At that time the navigable channel, with a minimum depth of 8 feet at low water, extended to a point within 2 miles of Salisbury. The extreme upper portion, as far as the mill dam in the heart of the town, was quite shoal, and had an average depth of only 18 inches at low tide. Between 1872 and 1885 a channel 75 to nearly 100 feet wide and 7 feet deep at low water was dredged from deep water below to the drawbridge in the town at a cost to the Government of about $50,000.

The present project, based upon a survey of the river made in 1889, provides for a channel 9 feet deep at mean low water from that depth below to the drawbridge at Salisbury, the width to be from 100 to 150 feet, at an estimated cost of $23,200.

On June 30, 1896, $19,473.60 had been expended on the present project, and the channel dredged to the approved dimensions from the drawbridge to opposite Williams Point, about 5,730 feet below. This left about 1 mile to be improved to complete the project. No work has been done during the past fiscal year. The entire amount expended for the improvement of the river to June 30, 1896, is $69,473.60.

The commerce of the river, which is quite varied, is reported for 1896 to have been 122,539 tons, of a valuation of $1,765,784. The improvement thus far made has facilitated navigation, and the reports received indicate a marked increase in the commerce of the river.

The river and harbor act of June 3, 1896, appropriated $3,700 for completing the improvement, and a contract has been made for the work to be done.

July 1, 1896, balance unexpended	$3,726.40
July 1, 1897, balance unexpended	3,726.40
July 1, 1897, amount covered by uncompleted contracts	3,726.40

(See Appendix H 15.)

16. Manokin River, Maryland.—Before improvements were commenced in 1891 the depth of water at the mouth of the river at the so-called "Mud Flats" was between 1 and 2 feet at low tide. These flats are about 2½ miles wide, and made navigation except at high water impossible, thereby rendering the upper part of the river, which has a very fair depth and width, almost useless for extensive shipping purposes. The average rise of the tide at the flats is 2.6 feet.

The adopted project for improvement is for a channel 6 feet deep at mean low water and 100 feet wide from Locust Point to Sharps Point, embracing the section called the "Mud Flats," at an estimated cost of $30,000.

Up to the close of the fiscal year ending June 30, 1896, $18,798 had been expended, and the proposed channel had been made 80 feet wide for a length of 3,520 feet, beginning at the lower end, and 60 feet wide the remainder of the distance across the "Mud Flats," the depth throughout being 6 feet at mean low water. Several abrupt points in the upper river above Sharps Point had been removed, and navigation upon the whole river at low tide thereby greatly improved. No work has been done on the improvement during the past fiscal year. Expenditures during the year were for office expenses.

The tonnage in 1891, when work was begun on this improvement, was 144,058 tons, and its valuation $2,282,630. Commercial statistics, stated to be incomplete, for 1896 give a tonnage of 59,704 and a valuation of $2,124,628.

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The river and harbor act of June 3, 1896, appropriated $4,000 for continuing the improvement, but directed that $2,000 of the appropriation should be expended in improving the river between Dashiells Creek and a point on the river known as the Red Bridge or county wharf. A contract was made for the dredging required.

July 1, 1896, balance unexpended	$4,202.00
June 30, 1897, amount expended during fiscal year	177.00
July 1, 1897, balance unexpended	4,025.00
July 1, 1897, amount covered by uncompleted contracts	[1] 4,025.00
Amount (estimated) required for completion of existing project	9,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	4,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix H 16.)

17. Pocomoke River, Maryland.—This river has been under improvement by the General Government since 1878. In 1879 and 1880 $12,500 was expended on work below Snow Hill, chiefly in the rectification of the channel by the turning off of sharp angles and giving increased width, the depth of excavation being to 7 feet at mean low water; and in 1888, with an appropriation of $8,000, a cut-off was made through the low neck of land forming four abrupt bends just below Snow Hill. At the close of these operations there was a channel not less than 80 feet wide and 7 feet deep between Snow Hill and Shad Landing, a distance of about 4½ miles.

The present project is based upon a survey made in 1894–95, and is for dredging the channel between Snow Hill and Shad Landing to a depth of 9 feet at mean low water and a width of from 100 to 130 feet, at an estimated cost of $14,000. The amount expended for the improvement of this river to June 30, 1896, is $20,500, which was on a previous project.

The river and harbor act of June 3, 1896, appropriated $5,000, the first appropriation on this project; and a contract for dredging has been made; work under the contract began on April 6, 1897, and closed June 3. The channel was dredged at 9 places between Nassawango Creek and the county wharf at Snow Hill, resulting in a 9-foot channel at mean low water, the width varying between 80 and 130 feet.

July 1, 1896, balance unexpended	$5,000.00
June 30, 1897, amount expended during fiscal year	4,487.26
July 1, 1897, balance unexpended	512.74
July 1, 1897, outstanding liabilities	373.63
July 1, 1897, balance available	139.11
Amount (estimated) required for completion of existing project	9,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	4,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix H 17.)

18. Queenstown Harbor, Maryland.—This harbor was last improved by the General Government between the years 1871 and 1880. In the latter year a project for making a channel 100 feet wide and 8 feet deep at mean low water from Chester River to the inner harbor was completed The amount expended for the improvement of this harbor to June 30, 1896, was $14,000, which was on previous projects.

[1] Of this amount $2,000 is for work in the upper river not covered by the project.

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The river and harbor act of June 3, 1896, appropriated $5,000 for continuing the improvement.

A contract was made for dredging and operations thereon began on April 22, and continued to June 15, 1897, when they were brought to a close, the project having been completed, resulting in a channel 8½ feet deep at mean low water and 100 feet wide from the Chester River to the inner harbor, a distance of 2,993 feet.

July 1, 1896, balance unexpended	$5,000.00
June 30, 1897, amount expended during fiscal year	3,288.73
July 1, 1897, balance unexpended	1,711.27
July 1, 1897, outstanding liabilities	200.00
July 1, 1897, balance available	1,511.27

(See Appendix H 18.)

19. Rockhall Harbor and inner harbor at Rockhall, Md.—The river and harbor act of June 3, 1896, appropriated $9,600 for Rockhall Harbor for completing improvement in accordance with report submitted by Gen. W. P. Craighill, Corps of Engineers, January 7, 1895; also $7,000 for improving inner harbor at Rockhall, in accordance with report submitted by Chief of Engineers in House Ex. Doc. No. 200, Fifty-third Congress, third session.

No work has heretofore been done at the bar outside or in the inner harbor by the General Government.

A project for the expenditure of the appropriations providing for a cut 80 feet in width across the bar and a cut 100 feet wide for the channel inside having been approved, a contract was made for the required work.

Dredging was begun June 14, 1897, on the 80-foot cut across Swan Point Bar, at the 10-foot curve in Swan Creek, and at the end of the month a cut of the approved dimensions had been made for a length of 810 feet. On the inner harbor dredging was begun on June 17, 1897, working inward, and at the end of the month a cut had been made of the approved dimensions for a length of 1,300 feet; a further length of 400 feet had been made 50 feet wide, and a further length 200 feet 25 feet wide, the depth being 10 feet at mean low water. The material dredged, 22,045 cubic yards of sand, clay, shells, and mud, was scowed away and deposited in shoal water on the west side under Swan Point Bar, below Huntingfield Point. It is expected that this improvement will be completed in a few months.

July 1, 1896, balance unexpended		$16,600.00
June 30, 1897, amount expended during fiscal year		699.10
July 1, 1897, balance unexpended		15,900.90
July 1, 1897, outstanding liabilities	$2,000.00	
July 1, 1897, amount covered by uncompleted contracts	13,000.00	
		15,000.00
July 1, 1897, balance available		900.90

(See Appendix H 19.)

20. Removing sunken vessels or craft obstructing or endangering navigation.—Wrecks in the upper Christiana River, Delaware.—The matter of the proposed removal of seven wrecks in the upper Christiana River, under consideration at the close of last fiscal year, was disposed of by embracing the removal of all obstructions between Churchman's bridge and Smalley's bridge in the work to be done with the $5,000 appropriated June 3, 1896, for the improvement of the river between those

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points. Of the five wrecks in that section three were removed during the progress of the work. It was decided also to remove the two wrecks below Churchman's bridge, one lying about 2,400 feet above that bridge at Newport and the other opposite the mouth of White Clay Creek, under the provisions of the act of September 19, 1890. After due advertisement contract was made, and the wrecks were removed by November 17, 1896, at a total cost of $444.23.

Wreck of barge Rose Hagen.—This vessel was sunk and submerged in 18 feet of water in Chesapeake Bay abreast of Sassafras River on the night of December 24, 1896. The wreck was reported April 7, 1897. At the time of the examination, April 22, a wrecking company was engaged in raising the vessel, and early in May the removal was accomplished and the barge towed away. The total expense, which was for the examination, was $9.42.

(See Appendix H 20.)

EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The preliminary examinations and surveys of the following localities, required by the act of June 3, 1896, were made by the local engineer, W. F. Smith, United States agent, major of engineers, United States Army, retired, and reports thereon submitted through the division engineer, Col. Peter C. Hains, Corps of Engineers:

1. Preliminary examination of St. Jones River, Delaware.—Major Smith submitted report of examination July 27, 1896. He is of opinion that the present and prospective demands of the commerce of this river warrant its improvement, and he estimates that a survey of the river to Dover, the head of navigation, will cost $1,050. The division engineer considers the river to be worthy of improvement by the United States to a limited extent, but whether the improvement will be justified depends upon the cost of it and its maintenance, and the cost can only be determined after a survey. The Chief of Engineers concurred in the views of the division engineer. The report was transmitted to Congress and printed in House Doc. No. 85, Fifty-fourth Congress, second session. (See also Appendix H 21.)

2. Preliminary examination of Mispillion River, Delaware.—Major Smith submitted report of examination July 27, 1896. It is his opinion that this river is worthy of improvement by the General Government, and a survey of the locality is estimated by him to cost $1,000. The division engineer concurs in this opinion, provided a thorough survey shall show the improvement to be justified by its cost. The Chief of Engineers concurs in the views of the division engineer. The report was transmitted to Congress and printed in House Doc. No. 110, Fifty-fourth Congress, second session. (See also Appendix H 22.)

3. Preliminary examination of Cedar Creek, Delaware.—Major Smith submitted report of examination July 6, 1896. It is the opinion of the local engineer, concurred in by the division engineer and by the Chief of Engineers, that Cedar Creek is not worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 79, Fifty-fourth Congress, second session. (See also Appendix H 23.)

4. Survey of La Trappe River, Maryland.—Major Smith submitted report September 22, 1896. Work on this river has been carried on by the United States under a project to secure a channel 11 feet deep at mean low water and 150 feet wide across the bar at the mouth, and to

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give a channel not less than 75 feet wide and 8 feet deep at mean low water in the river to Trappe Landing, at the head of navigation. This project has been completed, with the exception of the channel across the bar, where a length of about 1,200 feet needs widening by about 50 feet, for which work an estimate of $2,500 has been submitted. Major Smith states that as the present and prospective demands of commerce seem to be provided for, no survey has been made for increased width or depth of channel. The report was transmitted to Congress and printed in House Doc. No. 114, Fifty-fourth Congress, second session. (See also Appendix H 24.)

5. Survey of Cambridge Harbor, Maryland.—Major Smith submitted report of survey September 25, 1896. Work of improving this harbor has been carried on heretofore, and Major Smith is of opinion that the improvements made, if maintained and somewhat enlarged, will be sufficient for the present and prospective demands of commerce. A project is therefore submitted by him on those lines at an estimated cost of $8,120. The report was transmitted to Congress and printed in House Doc. No. 119, Fifty-fourth Congress, second session. (See also Appendix H 25.)

IMPROVEMENT OF PATAPSCO RIVER AND BALTIMORE HARBOR, MARYLAND.

This district was in the charge of Col. Peter C. Hains, Corps of Engineers, having under his immediate orders Lieut. Charles W. Kutz, Corps of Engineers, since October 2, 1896.

1. Patapsco River and channel to Baltimore, Md.—The original available depth from the deep water of Chesapeake Bay to Baltimore was 17 feet at mean low water. The average rise of tide is 18 inches. Vessels of 17 feet draft and over were obliged to lighter portions of their cargoes to the Baltimore wharves from about 14 miles below the city.

In 1853 the original project was adopted for a depth of 22 feet at mean low water and a channel width of 150 feet. In 1871 (Annual Report Chief of Engineers for 1871, pp 586–587) an estimate was made for a channel of 400 feet wide at its lower end, narrowing to 250 feet wide at its upper end, to be 24 feet deep at mean low water. In July, 1872 (Annual Report Chief of Engineers for 1873, p. 761), this work was commenced and in 1874 completed. A change in the position of the channel was also made, which lessened the distance and decreased the cost of maintenance. In 1892 the channel was completed to 27 feet depth at mean low water, 600 feet wide in the straight parts, and over 1,200 feet at the bends, that project having been authorized by Congress in the act of March 3, 1881 (Annual Report Chief of Engineers for 1881, pp. 134, 860–863). This project also included a change in the direction of the channel, called the Cut-off. One hundred thousan dollars in all was appropriated to maintain the channel after its completion. The act of June 3, 1896, contained the following:

> Improving deep channel in Baltimore Harbor, Maryland, in accordance with the project submitted December first, eighteen hundred and ninety-four, four hundred thousand dollars: *Provided*, That this sum may be used in the discretion of the Secretary of War, under the direction of the Chief of Engineers, for deepening the present channel to a depth of thirty feet.

The existing project under the above law was approved by the Secretary of War July 10, 1896. It provides for a channel 30 feet deep at mean low tide, with a bottom width of 600 feet, widened in the bends, and side slopes of three base to one vertical, from Fort McHenry to the deep water in Chesapeake Bay, near Sandy Point Light-House.

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The estimated cost is $2,500,000, with an annual expenditure of $50,000 for maintenance. The report upon which this estimate is based is submitted as Appendix I 5 of this report.

The amount expended up to the close of the fiscal year ending June 30, 1896, was $3,261,154.17. The sum given is the result of a revision of the finances from the beginning of the work.

June 30, 1896, the dimensions of the channel were 27 by 600 feet, as stated above, but this was found inadequate to the demands of the commerce of the port. Freight-carrying vessels and general marine architecture are tending toward an increase in bulk and draft.

With the funds provided by the act of June 3, 1896, a cut is being dredged to 30 feet depth in the middle of the existing channel. The work thus far accomplished under the new project, to June 30, 1897, consists in the removal, under contract, of 1,270,582 cubic yards of material, but the cut made is not fully available for the purposes of navigation and commerce at the end of the fiscal year.

The value of the annual commerce of the port in 1853, when this improvement was commenced, amounted to $20,000,000, and in the fiscal year ending June 30, 1897, it is $95,822,330, showing an increase of $75,822,330 as a resultant of the 27-foot improvement.

The tonnage movement of the port has been as follows:

Fiscal year ending June 30—	Tons.	Fiscal year ending June 30—	Tons.
1889	3,243,017	1894	4,752,946
1890	4,237,361	1895	4,794,964
1891	4,495,469	1896	5,363,894
1892	5,224,042	1897	6,868,120
1893	4,607,176		

July 1, 1896, balance unexpended		$454,875.83
June 30, 1897, amount expended during fiscal year		72,149.06
July 1, 1897, balance unexpended		382,726.77
July 1, 1897, outstanding liabilities	$500.00	
July 1, 1897, amount covered by uncompleted contracts	337,575.71	
		338,075.71
July 1, 1897, balance available		44,651.06

Amount (estimated) required for completion of existing project	2,100,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	800,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix I 1.)

2. Channel to Curtis Bay, in Patapsco River, Baltimore Harbor, Maryland.—Curtis Bay was originally a nearly circular harbor, about 4 miles below the city of Baltimore, with a natural depth of 22 feet at mean low water. It required connection with the main ship channel to Baltimore to be available for the deep-draft vessels using the port.

The originally adopted project (Annual Report, Chief of Engineers, 1893, p. 1249) was for a channel 150 feet wide at bottom and a depth of 27 feet at mean low water from the main ship channel in the Patapsco River to Curtis Bay, at a cost of $85,000. A channel of that width, but of 25 feet depth, was completed in 1893 with an appropriation of $28,000, made in 1892.

The amount expended up to the close of the fiscal year ending June 30, 1896, was $28,000.

The channel dredged answers all present needs of the navigation and commerce of the bay, and the appropriation of $12,000 in the act of August 17, 1894, is unexpended.

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Nothing was expended in the fiscal year ending June 30, 1897, and the channel remains with the same dimensions as at June 30, 1896.

Curtis Bay is in the collection district of Baltimore. Owing to the destruction by fire of a sugar refinery there, its commerce has not increased since the existing channel was completed, although the refinery has been reconstructed.

July 1, 1896, balance unexpended	$12,000.00
July 1, 1897, balance unexpended	12,000.00
Amount (estimated) required for completion of existing project	45,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix I 2.)

3. Harbor of Southwest Baltimore (Spring Garden), Md.—The original condition of the navigable channel way was that it had a controlling depth of 15 feet at mean low water in one portion, although the depth was greater in others. The width was contracted, but varying, the least being about 100 feet. Navigation was not available for the deep-draft vessels of the port of Baltimore.

The originally adopted project (Annual Report, Chief of Engineers, 1896, pp. 1005, 1006, and 1007) was for a channel 27 feet deep at mean low water, 100 feet wide at bottom, with side slopes of 1 on 3, from the main ship channel near Fort McHenry to the foot of Eutaw street, with a turning basin 400 by 400 feet near the upper end, at an estimated cost of $314,000.

There had been no expenditures up to the close of the fiscal year ending June 30, 1896.

The condition of the improvement June 30, 1896, is as stated in the first paragraph.

There were no operations in the fiscal year ending June 30, 1897, the appropriation of $5,000, in the act of June 3, 1896, being too small to accomplish any useful result.

This harbor is in the collection district of Baltimore, and the commercial statistics of that port include it.

Amount appropriated by act of June 3, 1896	$5,000.00
July 1, 1897, balance unexpended	5,000.00
Amount (estimated) required for completion of existing project	309,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix I 3.)

4. Removing sunken vessels or craft obstructing or endangering navigation.—Schooner Margaret Kennedy.—This vessel was wrecked off Fort Henry, Baltimore Harbor, Maryland, in 1895, and had been a menace to the navigation of small craft. After due advertisement the wreck was removed by the lowest bidder, at a cost of $125. The work was completed February 24, 1897.

(See Appendix I 4.)

SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The surveys of the following localities, required by the act of June 3, 1896, were made by the local engineer, Col. Peter C. Hains, Corps of Engineers, and reports thereon submitted:

1. Survey of Baltimore Harbor, Maryland, with a view to securing a channel 30 feet in depth.—Colonel Hains submitted report October 17,

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1896. No survey was necessary at this time, but from data available the local officer estimates that to deepen the channel to 30 feet at mean low water, with a bottom width of 600 feet and side slopes of 3 base to 1 vertical, will cost $2,500,000. To maintain the channel after completion will require an annual expenditure of $50,000. The report was transmitted to Congress and printed in House Doc. No. 50, Fifth-fourth Congress, second session. (See also Appendix I 5.)

2. Survey of Annapolis Harbor, Maryland, with a view to straightening, widening, and deepening the channel of the entrance to said harbor, so as to obtain a ship's channel of 150 feet wide and 28 feet deep at mean low water, from Chesapeake Bay to the wharves of the United States Naval Academy in said harbor.—Colonel Hains submitted report November 28, 1896. He states that there can be no question that the only practicable way to improve the navigation in the manner required by the act is to dredge a channel from the deep water of the bay to the inner harbor, and estimates that to dredge a channel 3½ miles long, with side slopes 1 on 3 and 28 feet deep at mean low water, will cost $142,000. The report was transmitted to Congress and printed in House Doc. No. 57, Fifth-fourth Congress, second session. (See also Appendix I 6.)

IMPROVEMENT OF POTOMAC RIVER AND ITS TRIBUTARIES, OF JAMES RIVER, VIRGINIA, AND OF CERTAIN RIVERS IN VIRGINIA ON WESTERN SHORE OF CHESAPEAKE BAY; PROTECTION OF JAMESTOWN ISLAND, VIRGINIA.

This district was in the charge of Lieut. Col. Charles J. Allen, Corps of Engineers, with Lieut. George P. Howell, Corps of Engineers, under his immediate orders to July 8, 1896, and Lieut. Jay J. Morrow, Corps of Engineers, since September 8, 1896.

1. Potomac River at Washington, D. C.—The Potomac River is navigable for vessels, both steam and sail, from its mouth to Georgetown, D. C., a distance of 113 miles. At Washington it changes its character from a distinctly fluvial to a tidal stream. The tide rises as far up as Little Falls, 3 miles above Georgetown, but the flood current is not perceptible above the latter. The mean range of tides at Washington is 3 feet.

At Little Falls, the actual head of navigation, the width of the river at low tide is 150 feet. The width just above the Aqueduct Bridge, which crosses the river at Georgetown, is about 1,200 feet. Below this bridge, along the water front of Georgetown, the width of the river gradually decreases for a distance of one-half mile to the foot of Thirty-first street, where the width is 730 feet. This part of the river is known as Georgetown Harbor, and its navigation was formerly obstructed by several dangerous rocks, which were removed in 1876 and 1883–1885. The depth obtained over these rocks by the improvement was 20 feet at low tide, which is now the ruling depth in the harbor. Georgetown has a wharf frontage of 4,000 feet, extending from the Aqueduct Bridge to the mouth of Rock Creek. At Easbys Point, 1 mile below the bridge, the river width is 974 feet. Prior to the reclamation of the flats the width of river sharply increased from Easbys Point to about 6,000 feet off the foot of Seventeenth street, about four-fifths of a mile below, and this last-named width substantially continued to Giesboro Point, nearly 4 miles below Easbys. Over a great part of this width there was a large deposit of the sediment carried by the river, resulting in the formation of bars in the channel and of wide flats on the left bank.

There were, in 1792, three channels in this part of the river, but since 1834 there have been but two, viz, the main, formerly called the George-

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town, but now known as the Virginia Channel, and the Washington Channel.

Long Bridge, 1¼ miles below Easbys Point, crosses both channels. The Virginia Channel was obstructed by two bars. The upper bar extended from Long Bridge to about one-half mile below Easbys Point. The ruling depth on this bar was 8 feet in 1857, while in 1871 it was 10 feet; in 1873 it was 13½ feet, and in 1881 15 feet. The improvement was due to frequent dredging, but after every freshet the dredged channel was nearly obliterated. The lower bar, 3,200 feet long, was near Giesboro Point, and in 1874 had a ruling depth of 14 feet, which was increased by dredging in 1874–75 to 16 feet. This was the ruling depth in 1881. Between these two bars the channel had depths of 20 to 30 feet. Below Long Bridge the Washington Channel was shoal; its ruling depth in 1878 was 10 feet for the greater part of the wharf front. Off the foot of N street the depth increased to 12 feet, thence gradually deepened to 22 feet off Greenleaf Point where the Anacostia River enters the Potomac.

The depth in the Washington Channel had been increased by dredging, so that in 1881 a depth of 16 feet could be found along the greater part of the wharf front.

The flats, which, under the conditions above noted, had, prior to the present project, been in gradual process of formation for a long time, extended from the Washington shore to the edge of the Virginia Channel. Between Easbys Point and the old Seventeenth Street Wharf a large area, in some places 1,500 feet wide, had been raised by accretions to a height of about a foot above mean low tide. Large quantities of sewage were carried at high tide over these flats and distributed by the flow among the rank growth of sedges and aquatic plants with which the flats were covered. As the tide fell this mass of sewage was left exposed to the rays of the sun. These conditions combined to generate effluvia which rendered the adjacent portions of the city almost uninhabitable, and at the same time were reported as causing malarial and other diseases.

The present, which is the original, project for improvement was adopted by the act of Congress of August 2, 1882. It has for its object the improvement of the navigation of the river by widening and deepening its channels, reclamation of the flats by depositing on them the material dredged from the channels, the freeing the Washington Channel, so far as it can be done, of sewage, and the establishment of harbor lines beyond which no wharves shall be built. To effect these the project provided for 20 feet depth in the channels at low water, for filling in the flats to a height of 3 feet above the flood plane of 1877, and for a tidal reservoir or basin above Long Bridge, to be provided with inlet and outlet gates of ample dimensions, to work automatically, and so arranged as to admit of the basin being filled from the Virginia Channel on the flood tide and discharged into the Washington Channel on the ebb. An ample system of drainage for the reclaimed area was also contemplated.

The project also provides for the rebuilding of Long Bridge at an early period during the progress of the improvement, with wide spans upon piers offering the least possible obstruction to the flow of water, and the interception of all sewage now discharged into the Washington Channel and its conveyance to the James Creek sewer canal, but neither of these works was included in the estimated cost of the improvement, which was $2,716,365. The estimate, as revised in 1897, is $2,953,020.

The total of appropriations for this improvement from August 2, 1882, to date is $2,285,000.

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The amount expended to June 30, 1896, inclusive, was $2,131,049.79. The work done to that date had resulted in the dredging of a channel 20 feet deep and 550 feet wide through the bar above Long Bridge and in restoring the standard 20-foot navigation by redredging shoals due to freshets; in widening the natural channel just below Long Bridge from 50 to 500 feet and deepening it to 20 feet; in dredging a channel 350 feet wide and 20 feet deep through the bar in the Virginia Channel near Giesboro Point; in dredging the Washington Channel to a width of 400 feet and depth of 20 feet; in dredging the junction of the Washington and Virginia channels; in dredging the Tidal Reservoir (111 acres) to a depth of about 8 feet; construction of the reservoir outlet, and construction of 38,885 linear feet of sea wall and 5,965 linear feet of training dike.

The work of the past fiscal year has consisted in laying sea wall on the Virginia Channel front and in the Tidal Reservoir; also in relaying a part of the old sea wall along the Washington Channel front of Section III of the flats. A contract was made March 9, 1897, for dredging to be done under the appropriation of $100,000 for the improvement made by the act of June 3, 1896, the work to begin July 1.

The benefits to commerce and navigation, from the work done, have been marked. Vessels of the draft now engaged in the coal trade from Georgetown were formerly unable to cross the bar in the Virginia Channel. Advantage has been taken of the increased depth in the Washington Channel by loading vessels for its wharves more heavily than formerly could be done. The value of the commerce to be benefited may be judged by examination of the following table showing the commerce of the port of Washington, in tons, from 1887 to 1896, inclusive:

1887	618,972	1892	766,954
1888	581,575	1893	653,433
1889	488,680	1894	644,588
1890	519,696	1895	693,450
1891	551,219	1896	723,657

The sum asked for the fiscal year ending June 30, 1899, is to be applied to work in furtherance of the project.

Congress, by act approved March 3, 1897, set aside the reclaimed flats, together with the tidal reservoirs, as a public park under the name of the Potomac Park, to be forever held and used as a park for the recreation and pleasure of the people.

July 1, 1896, balance unexpended		$153,950.21
June 30, 1897, amount expended during fiscal year		31,444.05
July 1, 1897, balance unexpended		122,506.16
July 1, 1897, outstanding liabilities	$1,914.00	
July 1, 1897, amount covered by uncompleted contracts	57,375.00	
		59,289.00
July 1, 1897, balance available		63,217.16

Amount (estimated) required for completion of existing project 668,020.00
Amount that can be profitably expended in fiscal year ending June 30, 1899 225,000.00
Submitted in compliance with the requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix J 1.)

2. Occoquan Creek, Virginia.—Occoquan Creek is a tributary of the Potomac River, which it enters about 25 miles below Washington, D. C. The stream is navigable from its mouth at Sandy Point to the town of

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Occoquan, a distance of 4 miles. Navigation was obstructed by four bars, which were improved between 1873 and 1880 by dredging and dike construction so as to secure a navigable depth of about 6 feet at low tide. Four appropriations were made from 1873 to 1878, amounting to $25,000, and in 1880 the improvement was regarded as completed. In compliance with the provisions of the river and harbor act of August 11, 1888, a new survey of the creek was made in 1889. The survey showed that of the channels dredged through Lower Mud, Upper Mud, Sand, and Occoquan bars, all, excepting that dredged through Upper Mud Bar, had filled in from 2 to 3 feet in depth since 1880. The act of September 19, 1890, appropriated $10,000 for improving the creek.

The project adopted December 5, 1890, for the new (present) improvement comprises dredging of channels 6 feet deep and from 100 to 150 feet wide through the four bars and construction of dikes required to secure the depths obtained by dredging. Estimated cost of the project $45,000.

The total of appropriations for the improvement from September 19, 1890, to and including June 3, 1896, is $22,500.

The amount expended to include June 30, 1896, was $19,896.94. It resulted in dredging channels from 100 to 150 feet in width and to a least depth of 6 feet through the four bars and in construction of 1,585 linear feet of dike at Occoquan Bar and Sand Bar.

No dredging or dike work was done during the fiscal year ending June 30, 1897. In March last the channels were examined in order to ascertain their condition. The shoaling at Lower Mud Bar on the sides of the channel had continued, making redredging necessary. It is proposed to do this redredging during the present season under the appropriation of June 3, 1896.

Commercial statistics of this creek, taken from Annual Reports, show receipts and shipments of coal, fertilizers, flour and grain, lumber, piling, railroad ties, wood, sand, and miscellaneous articles. The receipts and shipments, in tons, for 1891–1896, excepting 1893, are given in the following table of commercial statistics:

Receipts and shipments by water.

Year.	Tons.
1891	8,205
1892	56,705
1894	8,900
1895	10,475
1896	41,670
Total for five years	125,285

Of the total tonnage 76,400 tons was sand.

Comparing the expenditure of $19,896.94 upon the improvement, 1891–1896, with the 48,885 tons of freight carried through the channels for that period (sand not considered), we find an expenditure on the improvement of over 40 cents for every ton of freight so carried. If we consider the 76,400 tons of sand, then the expenditure per ton of freight carried is reduced to about 16 cents per ton.

In addition to the dredging remaining to be done through Lower Mud Bar, the dike at Sand Bar needs extension and a dike remains to be constructed at Upper Mud Bar.

The sum asked for the fiscal year ending June 30, 1899, is to be expended in dike construction and extension and in dredging.

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July 1, 1896, balance unexpended	$2,603.06
June 30, 1897, amount expended during fiscal year	138.06
July 1, 1897, balance unexpended	2,465.00
Amount (estimated) required for completion of existing project	22,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	6,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix J 2.)

3. Aquia Creek, Virginia.—This creek enters the Potomac River 41 miles below Washington. It is navigable to Wharton Landing, about 7½ miles above its mouth. The creek has a well-defined channel 60 to 200 feet wide in its upper part; the depth was originally 2 to 17 feet. At a point about 4½ miles above the mouth, called the Narrows, the stream suddenly expands into a bay 1,000 to 6,000 feet wide, resulting in a continuous shoal, on which the depth ranged generally from 2 to 4 feet, increasing to 7 feet near the mouth. About 3 miles above the mouth the creek is crossed by a trestle bridge of the Richmond, Fredericksburg and Potomac Railroad. The bridge has a draw 28 feet wide.

From 1872 to 1878, both years inclusive, Congress appropriated $10,500 for improving the creek. The amount was expended in dredging between Davis Point, one-third mile below the bridge, and Wharton Landing.

A new survey was authorized by the river and harbor act of August 11, 1888, and made in 1889. It showed that considerable filling had occurred below the railroad bridge.

The project for the new (the present) work, approved December 4, 1890, provides for a channel 80 feet wide and 6 feet deep to be dredged where less than 6 feet was found between the mouth and the Narrows. The estimated cost of this project was $40,000. It has since been reduced to $21,000.

The amount expended to June 30, 1896, was $17,227.24. The work done under this expenditure resulted in increasing the navigable depth to 6 feet for a distance of 4½ miles above the mouth and in increasing the channel width to 80 feet where it was originally but 40.

No work of dredging was done during the fiscal year ending June 30, 1897. An examination of the stream made in March last showed some slight shoaling on the left side of the channel below the railroad bridge. The uncompleted portion of the work near the Narrows was unchanged.

The funds from the appropriation of June 3, 1896, and an available balance of about $500 from the appropriation of August 18, 1894, will be expended during the present season in completing the project by dredging. No further appropriation will be required.

The work already done has been of benefit to the commerce of the creek by increasing the draft that can be carried by vessels.

Commercial statistics for the year 1895, the latest available, show that the trade amounted to 18,450 tons, the principal articles of commerce being farm produce, lumber, railroad ties, tobacco, and general merchandise.

July 1, 1896, balance unexpended	$3,772.76
June 30, 1897, amount expended during fiscal year	184.86
July 1, 1897, balance unexpended	3,587.90

(See Appendix J 3.)

4. Nomini Creek, Virginia.—Nomini Creek enters the Potomac River from the right bank about 82 miles below Washington. In 1872 its navigation was obstructed by a bar of oyster shells and sand at its

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mouth, over which but 3 feet could be carried at low tide. There was a strong cross current just within the mouth. After passing the bar the stream widens, and 8 feet can be carried for about 3½ miles to Nomini Ferry, while 5 feet can be carried for about 6 miles above the mouth.

The project for improvement, adopted in 1873, provided for dredging a channel through the bar 100 feet wide and 9 feet deep. The width was increased to 150 feet in 1879, in order to meet the increased trade. In 1885 the project was again modified by increasing the proposed width to 200 feet, at a cost of $62,500. In 1888 the estimate was increased to $72,500, the channel having shoaled on account of suspension of work from 1883 to 1889. It was difficult to secure permanent results, the channel being exposed to north and northwest winds and to cross-tidal currents. The deterioration of the channel outside White Point was thought to be largely due to material carried into the channel by the flood and ebb currents of Currioman Bay. In order to maintain the channel, the project was modified in 1890 to embrace the following: The dredged channel to be 150 feet wide and 9 feet deep; a jetty to be constructed from White Point on the east and one from Cedar Island on the west; dikes to be built inside White Point to check the cross currents; estimated revised cost, $72,500. Examination made in 1897 showed that the east jetty should be made 400 feet longer, and that both jetties should be made higher than originally projected, the increased cost bringing the estimate up to $105,000.

The amount expended to June 30, 1896, $56,437.79, resulted in a channel 150 feet wide and 9 feet deep and the construction of 819 linear feet of the east jetty. The channel inside the point has shoaled slightly, while the outer channel has shoaled about a foot. The ruling depth through the channel at low tide is 8 feet.

Amount expended during the fiscal year ending June 30, 1897, was for survey and in Treasury settlement of claim for dredging.

The total of freight transported through the channels under improvement, 1892–1896, is 87,433 tons. The freight carried was coal, farm produce, grain, lumber, oysters, railroad ties, general merchandise, and wood. The tonnage by years is given below.

The work required for completion of the project is completion of the east jetty, construction of the west jetty, and some redredging of the channels. The sum appropriated by the act of June 3, 1896, is to be applied during the present year to redredging the channels.

The sum asked for the fiscal year ending June 30, 1899, is to be applied to jetty construction and dredging.

Tonnage by years.

Year.	Tons.	Year.	Tons.
1889	13,542	1893	17,658
1890	15,825	1894	25,100
1891	62,300	1895	16,250
1892	*21,000	1896	7,425

*This calculation is for sailing vessels only. The steamers carry the great bulk of grain and merchandise.

July 1, 1896, balance unexpended	$3,562.21
June 30, 1897, amount expended during fiscal year	1,073.57
July 1, 1897, balance unexpended	2,488.64
Amount (estimated) required for completion of existing project	45,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	12,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix J 4.)

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5. Lower Machodoc Creek, Virginia.—This creek is a tidal estuary on the right bank of the Potomac River and about 85 miles below Washington, D. C. It has a navigable length of about 4 miles. The width between banks at the mouth is 1 mile, and between the 12-foot contours the channel width exceeds 3,000 feet. The lower part of the creek for a distance of 1½ miles above the mouth is three-fourths of a mile to 1 mile in width, with a navigable depth of 13 feet, affording a safe harbor during northeast to southeast storms.

At the Narrows, 2 miles above the mouth, the stream suddenly contracts to a width of 650 feet, and the channel is obstructed by a sand bar over which but 4 feet could be carried at low tide. This bar constituted the principal obstruction to navigation.

After passing Narrows Bar a depth of 10 to 14 feet is found in the channel, gradually shoaling to about 9 feet near "Cupelo Point," 3 miles above the mouth, and thence to about 6 feet at Drum Bay, the head of navigation, 4 miles above the mouth.

The present approved project, adopted November 29, 1892, provides for dredging a channel 150 feet wide and 9 feet deep at low tide through the bar at the Narrows, at an estimated cost of $15,000.

The total of appropriations, to include that of $1,500 by act of June 3, 1896, is $7,500.

The total of expenditures to the close of the year ending June 30, 1896, was $5,706.33. It resulted in a channel 150 feet wide, 6 feet deep on the sides, with a depth of 9 feet for a width of 70 feet in mid-channel. Length of the 9-foot dredged channel, 1,380 feet.

Expenditures during the fiscal year were applied to an examination of the channel and in office expenses. The examination showed that a small amount of shoaling had occurred since the dredging in April, 1896.

The benefit to navigation and commerce, from the work done, is largely prospective, for the reason that the bar completely closed the creek to the passage of steamers, and it is only since April, 1896, that 70 feet in width of the channel has had the depth desired. No statistics of the commerce and navigation of this stream could be obtained. It is reported that the steamer *Harry Randall*, of Randall's Potomac River Line, now makes weekly trips from Washington, D. C., through the channel to new wharves above Narrows Bar.

The work remaining to be done to complete the project is the dredging of the channel throughout its entire width of 150 feet to a depth of 9 feet. The sum appropriated for the improvement by act of June 3, 1896, is to be applied to this required dredging during the present season.

The sum of $3,000, asked for the fiscal year ending June 30, 1896, is to be applied to increasing the depth as required by dredging.

July 1, 1896, balance unexpended	$1,793.67
June 30, 1897, amount expended during fiscal year	228.07
July 1, 1897, balance unexpended	1,565.60
Amount (estimated) required for completion of existing project	7,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	3,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix J 5.)

6. Rappahannock River, Virginia.—The Rappahannock River is navigable from its mouth in Chesapeake Bay to Fredericksburg, Va., a distance of 106 miles. The lower part of the river has the character of a tidal estuary, the width varying from 1 to 3.5 miles. The ruling depth

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at the mouth is 5 fathoms, and this depth holds to Jones Point, 28 miles above, while 17 feet can be carried to within 1 mile of Tappahannock, which is 41 miles from the mouth. Above Tappahannock the river has a tortuous course, and above Port Royal, 29 miles from Fredericksburg, it flows between high banks. The width at Fredericksburg is about 350 feet, gradually increasing to about 1,500 feet at Port Royal. In 1871, prior to the inception of the improvement, 6 feet could be carried to within a mile of Fredericksburg, and thence 4 feet to the town.

The obstructions to navigation before improvement was undertaken were nine bars between Tappahannock and Fredericksburg over which the ruling depths were from 4 to 10½ feet. The chief obstructions were in the 12½ miles of river below Fredericksburg, and where seven of the bars were found. Of these bars, Fredericksburg Bar, with a least depth of 4 feet, and Spottswood Bar, 4 miles below Fredericksburg, with a least depth of 6 feet, caused the most delay to steamboats and vessels.

The original project, approved in 1871, was to secure a channel 100 feet wide and 10 feet deep by dredging and the construction of dikes from Fredericksburg to Tappahannock; the wrecks obstructing the channel to be removed. The first estimate of the cost of this improvement was $83,760. In 1879 the project was amended so as to provide for dredging a channel 100 feet wide and 10 feet deep through the bars between Fredericksburg and Port Royal, and one 200 feet wide and 15 feet deep between Port Royal and Tappahannock for a larger class of vessels; the depths secured by dredging to be maintained by a system of wing dams and training dikes to be built of piles and sheet piling, or of piles and brush or logs, the dikes being also required in some cases to secure the dredged material from being carried back into the river.

The total cost of the revised project, which is the present approved project, was estimated as $381,500.

The appropriations for this work from March 3, 1871, to June 3, 1896, aggregate $252,500.

The total amount expended, to include June 30, 1896, is $241,276.04. The results of the work to the latter date were the partial improvement of seven bars between Fredericksburg and Port Royal by means of dredging and construction of dikes and in the removal of all wrecks to that date which obstructed navigation.

The amount expended during the fiscal year ending June 30, 1897, was for survey and miscellaneous expenses.

The work already done has been of material relief to existing navigation in enabling steamers and vessels loaded for Fredericksburg and which were formerly detained at Spottswood Bar, 4 miles below Fredericksburg, to reach that city at all stages of the tide. The ruling depth at Spottswood Bar has been increased to 8.2 feet and that at Fredericksburg Bar to 8.6 feet, the depths on those bars before improvement was commenced having been, respectively, 6 and 4 feet. A draft of 9 feet can now be carried over all the bars below Spottswood Bar.

At Fredericksburg Bar, at the head of navigation, and a few miles below the head of tide water, new deposits of sand are formed by each recurring freshet. The experience of twenty-five years indicates that the improvement of the bars at and near Fredericksburg can not be made permanent excepting at heavy cost, and that repeated dredging will be needed for the removal of accretions. The Annual Reports for a number of years past have estimated that an annual appropriation of about $7,500 should be available for such dredging.

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The following table shows the tonnage of this river, by years, from 1888 to 1896, inclusive, the principal articles of commerce being grain, oysters, fertilizers, cattle, farm produce, and general merchandise:

Commercial statistics.

Tonnage for—	Tons.	Tonnage for—	Tons.
1888	83,600	1894	[1] 144,070
1890	83,830	1895	[1] 151,466
1892	[1] 126,333	1896	[1] 161,196
1893	[1] 141,750		

The work remaining to be done to complete the execution of the project is continuance of dredging and dike construction necessary to secure the required dimensions of channels.

The appropriation of $8,000 made by the act of June 3, 1896, and an unexpended balance of about $1,900 from the appropriation of August 18, 1894, will be expended during the present year in dredging and removal of a small amount of rock.

The sum of $15,000, estimated for the fiscal year ending June 30, 1899, is to be expended in removal of obstructions in accordance with the project.

July 1, 1896, balance unexpended	$11,223.96
June 30, 1897, amount expended during fiscal year	1,271.33
July 1, 1897, balance unexpended	9,952.63
Amount (estimated) required for completion of existing project	129,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	15,000.00
Amount required for maintenance in fiscal year ending June 30, 1899	7,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix J 6.)

7. Urbana Creek, Virginia.—Urbana Creek enters Rappahannock River from the right bank at a point about 16 miles above its mouth. In 1874 a bar existed outside the mouth over which but 6½ feet depth could be carried at low tide. In 1882 a shoal within the creek, having a least depth of 7 feet and near the town of Urbana, was regarded as obstructing steamboat navigation.

The project for improvement adopted in 1879 comprised excavation of a channel 150 feet wide and 10 feet deep through the outer bar. Estimated cost, $20,000. This project was modified in 1883 to include dredging through the inner bar, and in 1888 to include jetties at the mouth to maintain the channel. The revised estimated cost was $34,580.

On account of the exposed position of the channel through the outer bar the work suffered from the action of northwesterly winds, which caused shoaling in the channel and a diminution in its width. In April, 1897, a survey was made to determine the extent of change in the channels and an estimate rendered in June following of the cost of completing the project by dredging and construction of a jetty to protect the channel dredged through the outer bar. This cost, added to the amounts expended to date, increases the estimated cost of the present project to $70,000.

The appropriations for this work from March 3, 1879, to June 3, 1896, aggregate $30,500. The amount expended to June 30, 1896, was $27,441.80. It resulted in a channel 10 feet deep and from 130 to 150 feet wide through the outer bar and a channel 10 feet deep and 80 to

[1] Furnished by Mr. William D. Scott, Fredericksburg, Va.

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170 feet in width at the shoal within the creek, although the recent examinations indicate some deterioration of the channels at the last-named locality.

Amount expended during the fiscal year ending June 30, 1897, was for survey and in miscellaneous expenses. The improvement has been of benefit to commerce and navigation by permitting the entrance of sailing vessels to the creek and enabling one of the steamers of the Weems Line, Baltimore to Fredericksburg, to enter the creek and land at the wharf.

The value of the commerce and navigation of the stream is indicated by the following table of commercial statistics:

Commercial statistics.

Calendar year—	Reported by Mr. F. A. Bristow.	Reported by Mr. J. D. Gressitt.
	Tons.	*Tons.*
1891	19,500	22,100
1892	20,095	17,125
1893	55,885	61,290
1894	82,395	88,305
1895	66,530	92,320
1896	137,485	133,925

The principal articles of commerce are oysters, tobacco, railroad ties, coal, grain, and lumber.

For fuller details of statistics, as well as of the work done, reference is made to Appendix J 7 of this report.

With the $3,000 appropriated by the act of June 3, 1896, it is proposed to during the present season complete the dredging required in the outer channel.

The sum of $20,000, asked for the fiscal year ending June 30, 1899, is to be expended in dredging and beginning construction of the jetty for maintaining the depth in the outer channel.

July 1, 1896, balance unexpended	$3,058.20
June 30, 1897, amount expended during fiscal year	99.10
July 1, 1897, balance unexpended	2,959.10
Amount (estimated) required for completion of existing project	39,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix J 7.)

8. York River, Virginia.—York River is 41 miles long and discharges into Chesapeake Bay about 16 miles above Old Point. Entering the river, 24 feet can be carried for 32 miles, or up to Potopotank Bar, 9 miles below Westpoint. In 1880 the ruling depth on this bar was 18.5 feet. Westpoint Bar, the next obstruction to navigation, commences about 2 miles below and extends up to Westpoint. Before improvement it had a ruling depth of 15.5 feet.

The original project for improvement, adopted in 1880, proposed dredging channels 22 feet deep and 200 feet wide through the bars. In 1884, on account of growth of trade, the width was increased to 400 feet, and in 1887 the project was further amended to include construction of a dike along the right bank at Westpoint Bar to maintain the channel. Total cost of the revised, which is the present, project, $308,800.

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Total amount expended to June 30, 1896, is $210,305.17. It resulted in a dredged channel 105 feet wide and 22 feet deep at Potopotank and one 22 feet deep and 160 to 260 feet in width at Westpoint Bar. This latter channel narrowed and shoaled and had to be redredged. A training dike 7,639 feet long was constructed at Westpoint Bar, at which point the last dredging was done in 1895. An examination made in April, 1897, of the work at this bar showed that the part of the channel dredged in 1895 was in seviceable condition, it being 22 feet or more in depth and 150 to 200 feet wide, the dike evidently having the desired effect.

The ruling depth from the sea to Westpoint may be stated as 20 feet at low tide.

A large and important commerce has been benefited by this improvement. Westpoint has been for years the cotton-shipping point for the Southern Railway Company, and in 1894 there were shipped at this port 72,235 tons of cotton and 206,706 tons of general merchandise. The total of shipments for that year, as reported, was 379,808 tons. Seven hundred and fifty-eight arrivals and clearances of steamers drawing over 10 feet were reported for that year.

The Southern Railway Company in 1896 established a new terminal and shipping point at Norfolk, Va., and the freight carrying on the river is reported as having fallen off considerably in consequence of the transfer.

Efforts have been made to procure commercial statistics for years subsequent to 1894, but without success.

In view of the present, at least, falling off in commerce views of those regarded as most directly interested in the navigation of the river were sought as to the present needs, in the way of width and depth of channels, of vessels navigating the river. The weight of opinion appeared to be that the improvement should proceed notwithstanding the transfer of the said terminal and shipping facilities. Attention is invited to the correspondence in this connection attached to Appendix J 8 of this report.

In view of the present changed conditions the officer in charge suggests the policy of maintaining the channels already dredged so that, whenever required, work under the full project may be resumed. Extension of the Westpoint Dike and dredging are recommended, and the sum asked for the fiscal year ending June 30, 1899, is to be applied to this work.

The funds appropriated by the act of June 3, 1896, and the balance from the appropriation of August 18, 1894, will be applied this season to work under the project.

July 1, 1896, balance unexpended	$19,444.83
June 30, 1897, amount expended during fiscal year	1,472.95
July 1, 1897, balance unexpended	17,971.88
July 1, 1897, outstanding liabilities	10.00
July 1, 1897, balance available	17,961.88
Amount (estimated) required for completion of existing project	79,050.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix J 8.)

9. Mattaponi River, Virginia.—The Mattaponi is navigable for small steamers and vessels from its mouth to Aylett, about 39 miles, and can

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be made navigable for small barges from Aylett to Monday Bridge, 16 miles. The obstructions to a 5½-foot navigation below Aylett consist of seven bars, upon which the ruling depths at low tide vary from 2.4 to 3.8 feet. Above Aylett there are numerous bars, but no work on them has been proposed. The river was also obstructed by snags, overhanging trees, and wrecks.

The original project for improvement, adopted in 1880, provided for removal of snags, leaning trees, and wrecks below Monday Bridge and the improvement of the bars below Aylett so as to give a depth of 5½ feet at low tide and a channel width of 40 feet. This project was extended by the terms of the river and harbor act of July 13, 1892, which provided for the removal of snags as far up as Guineas Bridge, near Milford Station, on the Richmond, Fredericksburg and Potomac Railroad. Estimated cost of project, $72,100.

The total amount expended to June 30, 1896, inclusive, is $24,501.80. It resulted in removal of snags, logs, and overhanging trees from the river between Robinson Bar and Monday Bridge, and in construction of 2,297 linear feet of dike at Robinson Bar; also in keeping the river below Aylett clear of such obstructions. An examination of Line Tree and Latané bars was made in the spring of 1897.

The amount expended during the fiscal year was for survey and in engineering and office expenses.

The work already done upon this river has been of benefit to the existing commerce. Before work for improvement began the trade was very small. A steamer now runs between Westpoint and Walkerton, 29 miles, and a lighter draft one runs from the latter point to Aylett. Below Walkerton a number of vessels load with wood and lumber for coast ports.

The tonnage of the river, 1890–1894, was as follows:

1890	32,650	1893	36,420
1891	52,060	1894	39,300
1892	32,690		

In 1894 the arrivals and departures of vessels were 370, of a total tonnage of 54,400. Repeated efforts have been made to obtain commercial statistics of later date than the above, but without success.

The work remaining to be done on the project is the completion of the dikes at Robinson Bar, construction of those required at Latané Bar, dredging, and removal of snags and fallen trees which accumulate more or less every year.

The appropriation of June 3, 1896 ($2,500), together with the funds available from preceding appropriations, will be applied during the present year to dredging.

The sum asked for the fiscal year ending June 30, 1899, is to be expended in dredging and removal of obstructions.

July 1, 1896, balance unexpended	$5,298.20
June 30, 1897, amount expended during fiscal year	292.41
July 1, 1897, balance unexpended	5,005.79
July 1, 1897, outstanding liabilities	5.00
July 1, 1897, balance available	5,000.79
Amount (estimated) required for completion of existing project	42,300.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	3,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix J 9.)

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10. Pamunkey River, Virginia.—The Pamunkey River is navigable from its mouth, at Westpoint, on York River, to Hanovertown, a distance of about 59 miles. Seven feet of depth at low water can be carried to Buckland Bar, 38½ miles above Westpoint. Above this bar are six bars extending along the river for about 15¼ miles, the ruling depths on which vary from 5½ to 1½ feet, excepting on the upper, or Indian Table, bar, which is exposed at low tide. Besides these bars are logs, snags, and overhanging trees.

The project for improvement, adopted in 1880 and amended in 1885, contemplated 7-foot navigation to Bassett Ferry, 47 miles from Westpoint; thence 5 feet to Wormley Landing, 54 miles; thence 3 feet to Hanovertown, the 7-foot channel to have a width of 100 and the other channels 40 feet. The wrecks, snags, logs, and trees obstructing navigation between Garlick Ferry and Hanovertown were also to be removed. The cost of this amended project, and which is the present project, was estimated as $32,500.

The total of expenditures to June 30, 1896, was $21,509.01. It resulted in several times removing snags and similar obstructions from about 30 miles of river, in removing parts of seven wrecks, and in partly improving Spring and Skidmore bars, 43 and 47 miles, respectively, from Westpoint.

No field work, excepting an examination of bars, was done during the past fiscal year.

The commerce of this river amounted, according to reports, to 50,420 tons in 1893 and 42,250 tons in 1894, the greater part of the latter being railroad ties and wood. There is scarcely any trade on the 5 miles below Hanovertown. Commercial statistics for years subsequent to 1894 could not be obtained.

The work remaining to be done to complete the existing project consists in dredging, construction of dikes, and removal of snags and logs. The sum of $3,000, estimated for the fiscal year ending June 30, 1899, is to be applied to that work.

July 1, 1896, balance unexpended	$3,990.99
June 30, 1897, amount expended during fiscal year	308.15
July 1, 1897, balance unexpended	3,682.84
July 1, 1897, outstanding liabilities	5.00
July 1, 1897, balance available	3,677.84
Amount (estimated) required for completion of existing project	7,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	3,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix J 10.)

11. James River, Virginia.—[This work was in the charge of Col. Peter C. Hains, Corps of Engineers, until July 31, 1896.] Prior to 1870 a small sum had been expended with some advantage to navigation, but the improvement was not regularly undertaken by the United States until that year. The obstructions to navigation existing in 1870 consisted of artificial as well as natural ones. The artificial obstructions had been placed in the river during the last war to prevent the national fleets from reaching Richmond. These consisted of sunken vessels and other impediments. There were also remains of military bridges.

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The depths at mean low water in 1870, before operations commenced, were as follows:

Locality.	Distances.	Depths.
	Miles.	*Feet.*
Richmond to Goodes Rocks	2	8
Goodes Rocks	.25	7
Richmond Bar	.75	7
Richmond Bar to Drewry Bluff	3.75	9
Drewry Bluff to Curles	14	[1]7
Curles to Hampton Roads	80	14.8

[1] In bend, at Dutch Gap, now avoided by Dutch Gap Cut-off.

The original project was to give 18 feet depth at full tide to Richmond, with a channel width of 180 feet from Harrisons Bar to the city docks, the excavation in rock to be 18½ feet. The average rise of tide is 2½ feet. Work on this project was well advanced when Congress, July 5, 1884, adopted another one of 22 feet at mean low tide from Richmond to the sea. The width to be given the channel is 400 feet from the sea to City-point, 300 feet from there to Drewry Bluff, and thence 200 feet to Richmond, estimated to cost $4,500,000. A large part of the excavation has been and will be in solid rock, and the cost is necessarily great. Operations consist in dredging, rock excavation, and the contraction and regulation of the waterway by means of dikes and jetties.

The amount expended on the improvement, to include June 30, 1896, was $1,634,198.41, with the result that 16½ feet at low tide could be carried from the sea to the lower city limits of Richmond.

The work during the past fiscal year has consisted in earth, cobble, and hard and soft rock excavation and in building and repairing wing dams. In round numbers 24,000 cubic yards of earth, 1,800 of cobble, 25,500 of soft rock, and 6,900 of solid rock were excavated, and 2,700 linear feet of wing dams built during the year. A large quantity of the excavated material was utilized in dikes. This work added still further to the improvement, so that a depth of 18 feet at mean low tide can now be carried from the sea to within 1,600 feet of the lower city limits of Richmond. At high tide a depth of 19½ feet is available up to the lower city line. In addition a saving of about 5½ miles of difficult river has been effected by opening Dutch Gap Cut-off.

The value to commerce of this improvement can be appreciated by examination of the statistical table herewith giving the total tonnage of the river for the years 1890–1896:

	Tons.		Tons.
1890	743,122	1894	616,269
1891	739,308	1895	602,582
1892	616,755	1896	680,935
1893	663,625		

The principal articles of commerce are coal, building materials, fertilizers, ice, iron, lumber, ties, tobacco, and general merchandise.

With the available funds for this work removal of rock and work on dikes will be continued during the coming year so far as the funds will admit of.

The sum asked for the fiscal year ending June 30, 1899, is to be applied to rock excavation, dredging, dike work, etc.

The conditions of this work are such that the best and most economical results for the United States can be obtained from liberal appropriations.

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July 1, 1896, balance unexpended		$138,301.59
June 30, 1897, amount expended during fiscal year		68,331.70
July 1, 1897, balance unexpended		69,969.89
July 1, 1897, outstanding liabilities	$1,050.00	
July 1, 1897, amount covered by uncompleted contracts	25,000.00	
		26,050.00
July 1, 1897, balance available		43,919.89
Amount (estimated) required for completion of existing project		3,467,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		400,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix J 11.)

12. Protection of Jamestown Island, Virginia.—[This work was in the charge of Col. Peter C. Hains, Corps of Engineers, until July 31, 1896.] The river and harbor act of 1894 contained an item of $10,000 for protection of Jamestown Island. The shore had been wearing away for years from action of waves, and the erosion had reached a point where protection was required if the old landmark was to be preserved. The appropriation was applied to construction of a wall faced with granite laid without mortar in front of the threatened portion of the island, to grading and turfing the bank behind the wall, and to construction of several groins in front of it. This work was completed in 1895.

The soil of the island is light and easily moved. The funds did not admit of covering the part requiring protection with the kind of work desirable. Storms, especially those of the winter of 1895 and 1896, greatly damaged the work.

The river and harbor act of June 3, 1896, appropriated $15,000 for this protection. The work for protection will be resumed, with the funds available, as soon as satisfactory preliminary arrangements with reference to occupation of the ground are made. The work will consist principally of regrading the bank and levee where necessary and covering it with a slope wall of large stone laid in cement mortar, the toe of the wall to be protected by riprap, so far as the funds will admit of.

The following are the amounts and dates of appropriations for protecting Jamestown Island, Virginia:

August 18, 1894	$10,000.00
June 3, 1896	15,000.00
Total	25,000.00
July 1, 1896, balance unexpended	15,825.08
June 30, 1897, amount expended during fiscal year	99.53
July 1, 1897, balance unexpended	15,725.55

(See Appendix J 12.)

SURVEY MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The survey of *Chapel Point Harbor, Maryland*, required by the act of June 3, 1896, was made by the local engineer, Lieut. Col. (then Maj.) Chas. J. Allen, Corps of Engineers, and report thereon submitted January 26, 1897. In this report estimates are submitted for channels of 10 and 15 feet depth each, over two different routes, from wharf at

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Chapel Point to the channel of the Potomac River. The estimated cost of these channels ranges from $52,800 to $330,000. The local officer states that he is unable to see that any good reason exists for the expenditure by the United States of any money for the improvement of this harbor. The report was transmitted to Congress and printed in House Doc. No. 266, Fifty-fourth Congress, second session. (See also Appendix J 13.)

IMPROVEMENT OF NORFOLK HARBOR, VIRGINIA, AND ITS APPROACHES, AND OF RIVERS AND HARBORS IN SOUTHEASTERN VIRGINIA AND NORTHEASTERN NORTH CAROLINA.

This district was in the charge of Capt. Thomas L. Casey, Corps of Engineers, with Lieut. Charles W. Kutz, Corps of Engineers, under his immediate orders, to October 1, 1896. Division Engineer, Col. Peter C. Hains, Corps of Engineers.

1. Harbor at Norfolk and its approaches, Virginia.—Before the present project of improvement was begun in 1877 the harbor of Norfolk was obstructed by shoals at the mouths of the Eastern and Southern branches, the shoal in the Eastern Branch being about one-third of a mile long, with a low-water depth of 15 to 16 feet, that in the Southern Branch being short, and with a depth of 22 to 23 feet.

The approaches to the harbor were obstructed by shoals at Sewall Point, 3 miles long, having a low-water depth of 20 feet, and at the mouth of the Western Branch, 1 mile long, with a low-water depth of 19 feet. The depths of these shoals and the widths of the channels, particularly in the inner harbor, where encroached upon by the Portsmouth and Berkley flats, were insufficient for the requirements of the port.

The plan of improvement adopted in 1878 was to deepen and widen the channels at the mouth of the Southern Branch and along Portsmouth and Berkley flats in the harbor proper, and to improve the approaches to the harbor by dredging a channel 500 feet wide and 25 feet deep at ordinary low water through the shoals at Sewall Point and at the mouth of the Western Branch.

The revised project of 1885 is as follows: (1) To dredge a channel not less than 500 feet wide and 25 feet deep at ordinary low water from the deep water in Hampton Roads to Norfolk and the United States navy-yard on the Southern Branch, and also to dredge a channel in the Eastern Branch not less than 22 feet deep at ordinary low water, with a width of 700 feet at its mouth and of not less than 300 feet at the Norfolk and Western Railroad Bridge; (2) to ultimately dredge the entire area bounded by lines parallel to and 75 feet from the port-warden lines to a depth not less than 25 feet from Fort Norfolk to the United States navy-yard, and not less than 22 feet from the mouth of the Eastern Branch to Campostella Bridge, and to build a bulkhead at Berkley Flats.

To the project of 1885 there was added in 1890, under authority of the river and harbor act of that year, the dredging of an anchorage at the mouth of the Western Branch, with a depth of not less than 25 feet at ordinary low water, at an estimated cost of $150,000, which amount was added to the original estimate, making the total estimated cost of the improvement $1,041,774.56.

The amount expended on this improvement to June 30, 1896, was $884,241.33, from which resulted a channel not less than 500 feet wide and 25 feet deep at ordinary low water from Hampton Roads to Norfolk Harbor, a channel of the same depth and from 400 to 650 feet wide in

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the Southern Branch to the United States navy-yard, a channel not less than 22 feet deep at ordinary low water, and from 500 to 1,050 feet wide in the Eastern Branch to the Norfolk and Western Railroad Bridge, and the dredging of 58½ acres of the anchorage to the required depth, 17 acres requiring no dredging being also made available.

The channels of the harbor at that time were in fair condition, shoaling being noticed in only two instances. This is only slight and does not to any extent cause inconvenience to navigation. A channel with a least depth of 30 feet at ordinary low water, 300 feet wide, would be advantageous throughout the area covered by the present project, for the accommodation of deep-draft ships of the United States Navy and for the increasing traffic of the harbor.

The expenditures during the fiscal year ending June 30, 1897, amounted to $92,595.43.

Under a contract, 961,162 cubic yards of material, scow measurement, was removed. On Berkley Flats dredging was carried in to the limiting line of the project between the Norfolk and Southern Railroad Wharf, in the Southern Branch, and the wharf of the Cummer Lumber Company, in the Eastern Branch, except for small area between the former and Frey's sawmill; cuts were made through a shoal in the Eastern Branch between Town Point and the Old Dominion Steamship Company's dock; an additional width of 150 feet was given to the channel between the mouth of the Southern Branch and Hospital Point, and between the latter and Pinner Point it was widened 75 feet for 1,500 feet and 35 feet for a further distance of 1,700 feet. In the Eastern Branch the dredging was to a depth of 22 feet at ordinary low water, and at the other localities 25 feet depth was obtained at the same stage of the tide.

The commerce for the calendar year 1895 was reported to amount to 5,013,185 tons; that for 1896 amounted to 5,986,636 tons, indicating an increase over the former of 973,451 tons.

July 1, 1896, balance unexpended	$100,758.67
June 30, 1897, amount expended during fiscal year	92,595.43
July 1, 1897, balance unexpended	8,163.24
July 1, 1897, outstanding liabilities	370.00
July 1, 1897, balance available	7,793.24
Amount (estimated) required for completion of existing project	56,774.56
Amount that can be profitably expended in fiscal year ending June 30, 1899	56,774.56

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix K 1.)

2. Western Branch of Elizabeth River, Virginia.—This is a new work, the first appropriation for which was made in the act of June 3, 1896, and amounted to $45,000 for completing the improvement as proposed in the estimate submitted in compliance with joint resolution of Congress approved March 24, 1896.

A channel from 50 to 300 feet in width and 12 feet in depth at mean low water existed in the river, but was not sufficient to allow of the full loading of vessels desiring to make use of the waterway.

The original project adopted in 1896 contemplates the dredging of a channel 200 feet wide and 20 feet deep at mean low water, from the 20-foot contour in Norfolk Harbor, Virginia, for a distance of about 1 mile. No work had been done toward obtaining such a channel at the close of the fiscal year 1896, nor had any money been expended.

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Expenditures during the fiscal year ending June 30, 1897, were applied to removing, under contract dated November 7, 1896, 378,037 cubic yards of material; a 20-foot mean low-water channel 200 feet wide was obtained thereby from the 20-foot contour in Norfolk Harbor, Virginia, for a distance of 3,400 feet. For a further distance of 1,450 feet the channel has been dredged to a width of 100 feet.

There is reason to believe that the lower parts of this dredged channel will gradually shoal on account of cross-currents in the main stem of the Elizabeth River. This, however, can not be definitely stated until careful observation can be made after the completion of the dredg ing; the funds now available will amply suffice for this purpose.

The commerce during the calendar year 1896 is reported to have been 211,653 tons, but as complete statistics have not been given heretofore, no comparison can be had with that of past years.

July 1, 1896, balance unexpended		$45,000.00
June 30, 1897, amount expended during fiscal year		27,752.50
July 1, 1897, balance unexpended		17,247.50
July 1, 1897, outstanding liabilities	$4,561.14	
July 1, 1897, amount covered by uncompleted contracts	11,449.02	
		16,010.16
July 1, 1897, balance available		1,237.34

(See Appendix K 2.)

3. Nansemond River, Virginia.—This river is one of the important tributaries of Hampton Roads, Virginia, and is navigable at high water for vessels drawing 11 feet as far as the city of Suffolk, 16 miles from its mouth.

In 1872, before any improvement was undertaken, the navigable channel of the Nansemond River was 5 feet deep at low water, and was much obstructed by wrecks, snags, etc.

Between 1873 and 1878 the Government dredged a channel wherever necessary 8 feet deep at low water from Suffolk to Hampton Roads. The amount expended in obtaining this channel was $37,000.

The present adopted plan of improvement is to secure a channel not less than 100 feet wide at bottom, 12 feet deep at mean low water, from the head of navigation to the mouth of the Western Branch, 5.37 miles, including a turning basin 200 feet square 300 feet below Suffolk Bridge, by dredging and by the construction of spurs and training walls; and a channel of like depth from the mouth of the Western Branch to deep water at Town Point, 200 feet wide at bottom at its upper end and gradually increasing to at least 400 feet at its lower end, etc., the total estimated cost being, in round numbers, $152,500.

The amount expended on the present project to June 30, 1896, was $40,000, which was applied to dredging a channel 80 feet wide and 12 feet deep at ordinary low water through Suffolk Shoal, five other shoals between Suffolk and a point 3½ miles below, and shoals above and below the mouth of the Western Branch. The dredged channels are generally in good condition. Other shoals will require dredging before the construction of the works of permanent improvement can be commenced.

The work done during the fiscal year consisted in the removal of five small and three large trees from the channel 3 miles below Suffolk, Va., of which complaint had been made by vessel owners as interfering with the free navigation of the river.

The commerce of this stream is given as 61,405 tons during the calen dar year 1896, an increase of 1,704 tons over that of 1895.

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July 1, 1896, balance unexpended	$5,000.00
June 30, 1897, amount expended during fiscal year	82.87
July 1, 1897, balance unexpended	4,917.13
Amount (estimated) required for completion of existing project	107,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix K 3.)

4. Appomattox River, Virginia.—This river is one of the principal tributaries of the James River, into which it empties at City Point, Va. It is navigable as far as the city of Petersburg, about 11 miles from its mouth, and before improvement had a tortuous channel obstructed by shoals, over which there was about 6½ feet of water at high tide.

The project for this improvement was adopted in 1870, and provided for a channel 12 feet deep at mean high water, with such width as the volume of tidal flow should admit, $10,000 annually being estimated as needed for repairs to contracting works and for dredging shoals formed by freshets to which this stream is subject irregularly, and by which large quantities of sand are brought down and deposited in the navigable portion of the river.

The estimated cost of the improvement under the project adopted was $423,830. This amount was increased in 1893.

The amount expended by the United States on this improvement to June 30, 1896, was $428,709.87.

By 1875 a channel 60 feet wide and 12 feet deep at mean high water had been secured from Petersburg to Point of Rocks by dredging such shoals as required it, and by making a cut-off called "Puddledock Cut." This channel was subsequently increased to 80 feet; numerous shoals formed by freshets have been dredged and regulating and contracting works built.

About the only work remaining to be done to complete the permanent works of improvement is the extension of those already built, as proposed in the revised estimate of 1893, which may be found on pages 1336 to 1340 of part 2 of the Annual Report of the Chief of Engineers for that year.

No work has been done during the fiscal year. The expenditures were for care of plant.

The commerce for the calendar year 1896 is reported to be 81,318 tons. The last complete statistics obtained was in 1892, which showed the commerce to amount to 25,218 tons, which indicates an increase for the former over the latter of 56,100 tons.

It is estimated that $10,000 will be required for maintenance and repair of the improvement during the fiscal year ending June 30, 1899.

July 1, 1896, balance unexpended	$5,120.13
June 30, 1897, amount expended during fiscal year	529.47
July 1, 1897, balance unexpended	4,590.66
July 1, 1897, outstanding liabilities	40.00
July 1, 1897, balance available	4,550.66
Amount (estimated) required for completion of existing project	48,090.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	30,000.00
Amount required for maintenance and repair during fiscal year ending June 30, 1899	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix K 4.)

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5. Harbor at Cape Charles City, Va.—[This work was in the charge of William F. Smith, United States agent, major of engineers, U. S. A. (retired), until April 26, 1897.] This harbor is an artificial rectangular basin of about 10 acres area, originally excavated to a depth of 12 feet in a pond just back of the shore of Chesapeake Bay, about 12 miles north of Cape Charles. It is in Northampton County, and forms the shore terminus of the New York, Philadelphia and Norfolk Railroad Company, transfer of passengers and freight being made by boat to and from Norfolk, Va. The tide rises on an average about 2.6 feet.

The adopted project provides for dredging the harbor to a depth of 14 feet and the entrance thereto and the channels in Cherrystone Inlet and across Cherrystone Bar to a depth of 16 feet at mean low water, the width at the inlet and bar to be 100 and 200 feet, respectively, protecting the channel entering the basin by two stone jetties, one on the north side and the other on the south side. The dredging was estimated to cost $45,400 and the jetties $84,000 with $12,940 for contingencies.

At the close of the fiscal year 1896, $23,420.93 had been expended on this improvement in dredging about one-half of the area of the harbor to a depth of 14 feet, in widening the channel at the entrance and deepening it to 16 feet, and in removing part of the shoal in Cherrystone Inlet, about 1 mile below the harbor, to 16 feet. The improvements made have been beneficial to the commercial interests of the harbor. The channels are apparently in good condition, but the channel through the bar in Cherrystone Inlet should be widened to the projected dimensions and the jetty construction should be completed as soon as possible. The shoaling which has been observed is due to sand washed in the channel during stormy weather and was so decided as to necessitate redredging during the present fiscal year.

The funds expended during the fiscal year ending June 30, 1897, were applied to dredging and jetty construction. Under a contract, 14,457 cubic yards of material was removed and deposited inshore above Plantation Creek, resulting in a channel 1,600 feet long, 70 feet wide, and 16 feet deep at mean low water, extending from opposite the "Barrel House" to deep water in Cherrystone Inlet Channel.

A portion of the north jetty was constructed under contract. Previous to the commencement of work, the New York, Philadelphia and Norfolk Railroad Company, at its own expense, built 750 linear feet of the north jetty, consisting of an inner core of oyster shells, faced on the north and south sides with heavy stone. That constructed by the Government was in continuation of the work done by the railroad, and extends outward for a distance of 400 feet; in the construction of this portion, 722.23 cubic yards of brush mattress and 2,647.68 cubic yards of stone were consumed. The total cost was $7,762.70, or $19.40+ per linear foot.

July 1, 1896, balance unexpended	$11,579.07
June 30, 1897, amount expended during fiscal year	11,486.53
July 1, 1897, balance unexpended	92.54
July 1, 1897, outstanding liabilities	75.00
July 1, 1897, balance available	17.54
Amount (estimated) required for completion of existing project	107,340.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	40,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix K 5.)

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6. Nandua Creek, Virginia.—Nandua Creek is an arm of Chesapeake Bay, extending about 7 miles into the eastern shore of the bay, 26 miles north of Cherrystone Light.

A survey of the creek was made to comply with the river and harbor act of August 18, 1894, and a report thereon submitted June 17, 1895. In this report it was stated that a channel across the bar at the mouth, 100 feet wide and 8 feet deep at mean low water, would cost about $6,000.

The first appropriation ($3,000) for this improvement was made in the river and harbor act of June 3, 1896.

The project submitted for the expenditure of the appropriation had not been approved at the close of the fiscal year, the Secretary of War having decided to take no action looking to the expenditure of the funds at this time; consequently no work has been done or expenditures made.

The commerce of the creek for the calendar year 1896 is reported to be 6,125 tons, valued at $112,940.

July 1, 1896, balance unexpended	$3,000.00
July 1, 1897, balance unexpended	3,000.00
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	3,000.00

(See Appendix K 6.)

7. Inland water route from Norfolk Harbor, Virginia, to Albemarle Sound, North Carolina, through Currituck Sound.—This is one of the most important links in the chain of inland water communication along the Atlantic coast.

It connects Chesapeake Bay with Albemarle Sound, and is composed of the following bodies of water, viz, Elizabeth River, North Landing River, Currituck Sound, Coanjock Bay, North River, and the Albemarle and Chesapeake Canal. With the exception of the canal, which was constructed and is maintained by private enterprise, all are natural waterways.

Before any improvement was undertaken by the Government there was over this route an indifferent channel 5 to 7 feet deep at low water, the navigation of which was obstructed by overhanging growth, snags, and sharp bends in all the rivers.

The project adopted was to secure a channel 80 feet wide and 9 feet deep at low water over the entire route (about 58 miles) by dredging, by removing obstructions, and by constructing a dike.

The waterways mentioned above were under separate improvement until September 19, 1890, when an appropriation was made to cover all. An aggregate of $240,169.69, including the expenditures to June 30, 1897, for removing sunken logs from North Landing River, had been expended on the separate works, and resulted in a channel 25 to 80 feet wide and 8 to 9 feet deep throughout the entire route.

Since the date of consolidation $28,163.96 had been expended to June 30, 1896, resulting in the removal of nine shoals in the Elizabeth River to a depth of 9 feet at low water and a channel width of 50 feet; a channel 600 feet long and 25 feet wide through another shoal; a channel 80 feet wide in North River from the southern end of the North Carolina cut of the Albemarle and Chesapeake Canal to a point 2,000 feet southward from Beacon No. 9, and a channel 70 feet wide in Currituck Sound between Beacons Nos. 5 and 6, the depth obtained

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in each instance being 9 feet at low water. The improvements made have been beneficial to the commercial interests of the route.

At a good many localities the channels are too narrow and devious for navigation by the long tows of lumber barges and rafts passing through the route. They should be dredged to the projected width without delay.

The expenditures during the fiscal year ending June 30, 1897, were applied to removing 51 sunken logs from North River, North Carolina, and to the payment of a portion of the expenses for similar work on the North Landing River, Virginia and North Carolina, which forms part of this improvement.

The commerce of this route during the calendar year 1896 is reported to be 322,947 tons, valued at $7,600,049.

July 1, 1896, balance unexpended	$10,836.04
June 30, 1897, amount expended during fiscal year	1,948.61
July 1, 1897, balance unexpended	8,887.43
Amount (estimated) required for completion of existing project	29,667.08
Amount that can be profitably expended in fiscal year ending June 30, 1899	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix K 7.)

8. North Landing River, Virginia and North Carolina.—This river forms a part of the "Inland water route from Norfolk Harbor, Virginia, to Albemarle Sound, North Carolina."

Before its improvement the navigation of this river was obstructed by shoals, over which the depth was 6 feet at low water, by snags, and by sharp bends.

The plan of improvement, adopted in 1879, was to secure a channel 80 feet wide and 9 feet deep at low water by dredging shoals and removing bends and obstructions.

This project was completed June 30, 1884, at a cost of $49,777.34, and the desired channel obtained for a distance of 17 miles. Since that time $7,892.35 has been expended on this river in removing sunken logs which have become detached from passing rafts, making a total expenditure on this improvement to June 30, 1897, of $57,669.69.

The only active work done during the fiscal year was in removing sunken logs from the channel between North Landing Bridge and a point 4½ miles below the bridge, by hired labor, with the snag boat *Roanoke*, 747 logs, 2 stumps, 3 trees, and 2 long piles being removed.

No further appropriation will be required, as this improvement forms a part of the inland water route and is included in the project for the improvement of the latter.

July 1, 1896, balance unexpended	$723.81
June 30, 1897, amount expended during fiscal year	723.81

(See Appendix K 8.)

9. Roanoke River, North Carolina.—When the United States commenced this improvement, 1872, navigation by vessels of 10 feet draft was embarrassed by the wreck of a gunboat 6 miles above the mouth of the river and by war obstructions at two other points, 9 and 13 miles above its mouth. The river was also somewhat obstructed for that draft by snags in the channel and by leaning trees 67 miles to Indian Highland Bar; thence 62 miles up, to Weldon, its channel depth on the bars was not less than about 5 feet during about eight months annually, affording a continuous low-water navigation of not more than 2 or 3

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feet, and its channel was badly obstructed by snags, logs, stumps, and leaning and overhanging trees.

The original project of 1872 is to secure at all seasons of the year an unobstructed channel with a least width of 50 feet from the mouth 129 miles to Weldon, with a low-water depth of 5 feet from Hamilton 67 miles to Weldon, and to clear the natural channel of snags and artificial obstructions from the mouth 62 miles to Hamilton to the depth requisite for vessels navigating the North Carolina sounds, which draw not more than 8 feet, by removing the war obstructions, snags, fallen and overhanging trees, sand bars, and ledges, by dredging, the construction of training dikes, and blasting, at an estimated cost, at the high prices of that time, of $269,000.

To June 30, 1896, $184,154.64 had been expended on this improvement.

At that date the natural channel depth was not less than 10 feet from the mouth 67 miles to Indian Highland Bar at extreme low water, and was, at ordinary low water, not less than 5 feet thence 62 miles to Weldon, except upon sand bars 150 feet long at Spring Gut 21 miles above Hamilton, about 1,600 feet long at Halifax 57 miles above Hamilton, and about 800 feet long 1¼ miles below Weldon, and upon a ledge of rock, about 2,800 feet in length, extending from Old Weldon Ferry up to Old Weldon Landing, the depth at these four localities being 4 feet at ordinary low water, assumed at the zero of the Weldon gauge.

The expenditures during the fiscal year ending June 30, 1897, were applied to removing 45 trees, 4 logs, 9 stumps, and 7 snags from the channel between Plymouth and Halifax, N. C., and to repairs to the snag boat with which this work was performed.

A survey will be made during the coming autumn to determine what further work, if any, is necessary on the river. The commerce has decreased materially since 1894, and it is possible that the existing channel will meet all requirements of navigation on the stream. The contemplated survey will decide this more positively. The present available balance will probably be enough to make any needed improvement of the channel justified by the present commerce and for the removal of obstructions lodged in the channel during freshets for several years to come.

July 1, 1896, balance unexpended	$45,183.36
June 30, 1897, amount expended during fiscal year	5,641.85
July 1, 1897, balance unexpended	39,541.51
July 1, 1897, outstanding liabilities	535.00
July 1, 1897, balance available	39,006.51
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	41,000.00

(See Appendix K 9.)

10. Pasquotank River, North Carolina.—When the United States began this improvement, in 1891, the river had a wide channel, nowhere less than 9½ feet in calm weather and 8 feet in northerly winds, from Albemarle Sound up 17 miles to Elizabeth City, and a narrower but good channel, but little obstructed, not less than 7 feet deep, 13 miles farther up, to the entrance of the Dismal Swamp Canal at the lower end of Turners Cut; thence about 5 miles to the original terminus of the canal and upper end of Turners Cut in a tributary, the Moccasin Track, 1,100 feet above its confluence with the river, the natural depth was not less than 5 feet, and the channel very sinuous and badly choked with snags

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and stumps and obstructed by overhanging trees, and above the Moccasin Track the river was likewise choked and obstructed.

The original project of 1889 was first to clear the 5 miles of channel in the river and Moccasin Track from the lower end of Turners Cut to the original terminus of the canal; and, second, to clear out the river 6 miles farther to Lebanon Bridge, for navigation by pole or flat boats, at an estimated cost of $9,000.

The sum of $4,644.23 had been expended to June 30, 1896, of which $4,596.98 was expended under the present project.

At that date, for boats of the draft that can navigate the canal, the river channel was unobstructed up to the entrance of the canal at the lower mouth of Turners Cut.

No work has been done upon the river during the fiscal year ending June 30, 1897, and there were no expenditures made.

July 1, 1896, balance unexpended	$2,403.02
July 1, 1897, balance unexpended	2,403.02

(See Apendix K 10.)

11. Removing sunken vessels or craft obstructing or endangering navigation.— Wrecks of schooners Henry Lippitt and John C. Haynes.—These wrecks were sunk in Hampton Roads, Virginia, the former about five-eighths of a mile south-southwest from Old Point Comfort Wharf in from 65 to 68 feet of water at low tide, and the latter seven-eighths of a mile in the same direction from the wharf and in from 53 to 57 feet of water.

After due advertisement a contract was entered into to break them up, and work thereunder was commenced on March 6, 1896. The work was completed July 15, 1896, and cost $6,199.99, $5,700 of which was expended during the fiscal year 1897.

Wreck of steamer Wyanoke.—This vessel was sunk by collision off Newport News, Va., in 56 feet of water on April 28, 1896.

Being reported an obstruction to navigation, an allotment of $20,000 was made September 28, 1896, for her removal.

The work was advertised in the usual manner, and a contract entered into for the performance thereof December 7, 1896. Work thereunder commenced March 9, 1897, and was still in progress at the close of the fiscal year. Since its inception, work has been confined to the removal of wreckage and mud from the decks and of cargo from the hold to obtain space for the placing of inflatable air bags.

The expenditures during the fiscal year 1897 have been for advertising, printing, inspection and office expenses, and amounted to $594.26.

Wreck of steamer Helen Smith.—This steamer sunk off the sawmill wharf at Money Point, in the Southern Branch of the Elizabeth River, Virginia, in 14 feet of water. Being an obstruction to navigation, an allotment of $220 was made for her removal on June 7, 1897.

Bids for doing the work were opened June 30, 1897, the lowest bid being $100.50.

No expenditures have yet been made on account of this wreck.

(See Appendix K 11.)

EXAMINATIONS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The preliminary examinations of the following localities, required by the act of June 3, 1896, were made by the local engineer, Capt. Thomas

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L. Casey, Corps of Engineers, and reports thereon submitted through the division engineer, Col. Peter C. Hains, Corps of Engineers:

1. Preliminary examination of Cashie River, North Carolina.—Captain Casey submitted report of examination October 19, 1896. It is his opinion, concurred in by the division engineer and by the Chief of Engineers, that Cashie River is not at present worthy of improvement by the General Government to a further extent than the removal of snags, leaning trees, and similar obstructions. The report was transmitted to Congress and printed in House Doc. No. 88, Fifty-fourth Congress, second session. (See also Appendix K 12.)

2. Preliminary examination of Potecasi Creek, North Carolina.—Captain Casey submitted report of examination October 19, 1896. In the opinion of the local officer, concurred in by the division engineer and by the Chief of Engineers, this stream is not worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 124, Fifty-fourth Congress, second session. (See also Appendix K 13.)

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN NORTH CAROLINA.

This district was in the charge of Lieut. Col. D. P. Heap, Corps of Engineers, to March 12, 1897, and of Capt. W. E. Craighill, Corps of Engineers, since that date, these officers having under their immediate orders Lieut. Edgar Jadwin, Corps of Engineers. Division Engineer, Col. Peter C. Hains, Corps of Engineers, since March 13, 1897.

1. Ocracoke Inlet, North Carolina.—In 1828 vessels drawing 9 feet could cross the ocean bar and enter the inlet at low water, but immediately within the inlet their passage to Pamlico Sound was barred by the inner shoals, over which not more than 5 feet could be carried.

For the improvement of these inner shoals the project of 1827 was to dredge a cut 10 feet deep at high water and 400 feet wide at the head of Wallace Channel. Dredging was commenced in 1830, and the depth was increased 3½ feet by the expenditure of $133,732.40[1] to 1837, when the improvement was abandoned because of the shoaling of the dredged channel and destruction by a gale of a jetty built to prevent that shoaling.

The controlling depth at mean low water in the channel navigated over the inner shoals was in 1891, as in 1894, 7½ feet, and the depth in the channel on the bar at the ocean entrance to the inlet was 14 feet in 1891 and 1892 and 12 feet in 1894.

The project of 1889 was to dredge a channel 300 feet wide through the shoals which, immediately within this inlet, are interposed between it and the requisite depth in Pamlico Sound, at an estimated cost, if 10 feet deep, of $100,000; if 13 feet deep, of $190,000, or if 15 feet deep, of $280,000, and to protect the channel so dredged by such training walls or protecting dikes as may possibly prove necessary, at an estimated additional cost of $320,000.

In May, 1894, the project was modified to dredge Teachs Hole Swash Channel to the depth of 9 feet and width of 400 feet, at an estimated cost of $29,339.38; or, if that channel shoal so rapidly as to make its abandonment advisable, to dredge a cut 9 feet deep and 300 feet wide at the head of Blairs Channel, at an estimated cost of $28,000.

July 9, 1894, the project was again modified to dredge cuts 9 feet

[1] In addition to this amount, $17.60 was carried to the surplus fund.

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deep at mean low water and 300 feet wide, about 5,000 feet long at the head of Wallace Channel and about 700 feet long in Beacon Island Slue, at an estimated cost of $51,513.39, to obtain a channel 9 feet deep from the inlet through the inner shoals to Pamlico Sound.

To the close of the fiscal year ending June 30, 1896, $41,746.75 had been expended.

At that date dredging was in progress at the head of Wallace Channel. A cut had been dredged across Royal Shoal at this point 150 feet wide, and a part of the cut had been widened to 270 feet. Nothing had been done at Beacon Island Slue.

As a result of the expenditures during the past fiscal year, the project of July 9, 1894, has been completed.

The commerce during 1896 (estimated) amounted to 50,000 tons, a gain of 19,777 tons over that of last year.

No transportation lines were established during the year.

July 1, 1896, balance unexpended	$63,253.25
June 30, 1897, amount expended during fiscal year	45,870.22
July 1, 1897, balance unexpended	17,383.03
July 1, 1897, outstanding liabilities	488.16
July 1, 1897, balance available	16,894.87

Amount that can be profitably expended in fiscal year ending June 30, 1899 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	(1)

(See Appendix L 1.)

2. Fishing Creek, North Carolina.—From its confluence with the Tar River, 94 miles above Pamlico Sound, up to Wilmington and Weldon Railroad Bridge, Fishing Creek is from 35 to 150 feet wide, with controlling channel depth on its bars of 3 feet at the average high-water stage of winter and spring. It is obstructed by many snags.

The project of 1889 as modified in 1896 is to clear out the natural obstructions up to the Wilmington and Weldon Railroad Bridge, at an estimated cost of $22,750, and to maintain the improvement.

Thirty-seven dollars and three cents had been expended on this improvement up to June 30, 1896.

The acts making appropriations provide that the money shall not become available until draws are provided in such bridges as are, in the opinion of the engineer in charge, unreasonable obstructions to navigation.

At that date the channel was in its original condition.

During the fiscal year ending June 30, 1897, commencing at its mouth, for about 12 miles the channel has been cleared of logs and snags and the banks for the same distance cleared of overhanging trees and brush likely to obstruct navigation.

The commerce during 1896 amounted to 1,000 tons, a loss of 700 tons since last year.

No transportation lines were established during the year.

It is estimated that $1,500 will be required for maintenance of the improvement during fiscal year ending June 30, 1899.

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[1] Present available balance sufficient, should it become necessary to maintain the project depth (which has been obtained) by redredging.

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July 1, 1896, balance unexpended	$14,962.97
June 30, 1897, amount expended during fiscal year	5,648.52
July 1, 1897, balance unexpended	9,314.45
July 1, 1897, outstanding liabilities	828.95
July 1, 1897, balance available	8,485.50
Amount (estimated) required for completion of existing project	7,750.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	7,750.00
Amount required for maintenance during fiscal year ending June 30, 1899	1,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix L 2.)

3. Pamlico and Tar rivers, North Carolina.—(One river, called the Pamlico below and the Tar above Washington.) When the United States began to improve it, in 1877, its channel was obstructed by piles, wrecks, and bars. Between Washington and Tarboro the available depth exceeded 2 to 3 feet not more than eight months annually, and above Washington the entire river was more or less obstructed by snags, logs, and stumps in the channel and by trees overhanging from its banks.

The project is that adopted in 1875, to secure by dredging and removal of war obstructions a clear and safe channel 9 feet deep at low water up to Washington; extended in 1879 to clear a channel 60 feet wide, 3 feet deep at low water 22 miles farther to Greenville, and 20 inches deep at low water 26 miles farther to Tarboro; again extended in 1889 to clear the river to its natural dimensions 40 miles farther to Little Fall, 2 miles below Rocky Mount, by removal of war obstructions, snags, logs, stumps, and overhanging trees, at a total final cost estimated in 1891 at $137,200. The project was extended in 1894 to include maintenance between Washington and Tarboro.

To the close of the fiscal year ending June 30, 1896, $92,801 had been expended.

At that date the river between Tarboro and Washington was clear of snags and the project width and depth existed. Above Tarboro the river had been roughly snagged several years before. Many stumps were in the channel below Washington, where the minimum depth was 7.5 feet.

By the expenditures of the fiscal year ending June 30, 1897, the river was cleared of snags from Fishing Creek to Greenville (34 miles), a channel below Washington 3,850 feet long and 200 feet wide was cleared of troublesome stumps, and for 2¼ miles below this point the snags were removed from the channel.

The commerce during 1896 amounted to 251,887½ tons, a gain of 68,660¾ tons over that of last year.

No transportation lines were established during the year.

It is estimated that $3,000 will be required annually for maintenance of the improvement, including snagging.

July 1, 1896, balance unexpended	$10,199.00
June 30, 1897, amount expended during fiscal year	5,058.07
July 1, 1897, balance unexpended	5,140.93
July 1, 1897, outstanding liabilities	27.04
July 1, 1897, balance available	5,113 89
Amount (estimated) required for completion of existing project	38,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	38,500.00
Amount required for maintenance and snagging during fiscal year ending June 30, 1899	3,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix L 3.)

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4. Contentnia Creek, North Carolina.—When the United States began to improve it, in 1881, it was badly choked with fallen timber, snags, logs, stumps, sand bars, and dense overhanging growth.

The project of 1881, amended in 1894 to include maintenance below Snow Hill, is, by clearing it of these obstructions, to obtain from its confluence with the Neuse to Stantonsburg, 63 miles, a depth of not less than 3 feet during the higher stages of about nine months' duration annually at a cost estimated in 1888 at $77,500.

To June 30, 1896, there had been expended $64,394.56.

At that date the creek between Snow Hill and its mouth was fairly clear of snags. Navigation, except during freshets, was prevented by several shoals near the mouth. On one of these the available depth was 1.4 feet at the stage assumed as the datum.

By the expenditures of the year ending June 30, 1897, the shoals have been removed by dredging, and the creek has been cleared of snags from Snow Hill to its mouth.

The commerce during 1896 amounted to 16,804¾ tons, a gain since last year of 4,186¾ tons, excluding timber. Extreme low water curtailed this item largely.

No transportation lines were established during the year.

It is estimated that $2,000 will be required annually for maintenance of the improvement, including snagging.

July 1, 1896, balance unexpended	$4,605.44
June 30, 1897, amount expended during fiscal year	2,474.94
July 1, 1897, balance unexpended	2,130.50
July 1, 1897, outstanding liabilities	88.10
July 1, 1897, balance available	2,042.40
Amount (estimated) required for completion of existing project	8,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	5,000.00
Amount required for maintenance and snagging during fiscal year ending June 30, 1899	2,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix L 4.)

5. Trent River, North Carolina.—When the United States began to improve it, in 1879, there was a channel 6 feet deep, comparatively free from obstructions, from Newbern, 18 miles, to Polloksville. Above Polloksville it was obstructed by bars of sand and rock, and especially by great numbers of snags in the 11 miles from Lower Quaker Bridge up to Trenton. One steamer ran regularly to Polloksville, and one occasionally 9 miles farther, to Lower Quaker Bridge, above which point navigation was confined to flatboats and rafts.

The project of 1879, extended in 1886 to include an 8-foot channel through Foys Flats above Newbern, was to secure a channel 3 feet deep at low summer stage from Polloksville to Trenton, by removing all obstructions and dredging a cut 50 feet wide through the shoals at a cost estimated in 1887 at $59,000.

In 1889 the project was extended to remove obstructions to permit navigation by small steamboats 33 miles above Trenton, and by pole boats 6½ miles farther, to Upper Quaker Bridge, at an additional cost of $13,000.

In 1892 the project was extended to include maintenance below Trenton, and in 1896 so as to provide only for maintenance of a channel 30 feet wide and 3 feet deep to Trenton.

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To the close of the fiscal year ending June 30, 1896, $64,262.64 had been expended.

At that date a channel 30 feet wide and 3 feet deep at low water had been completed to Trenton and was clear of snags.

There have been no expenditures during the year except for maintenance of plant, etc.

There was no change of importance in the condition of the river during the year.

The commerce during 1896 amounted to 142,100¾ tons, a loss of 341¾ tons since last year.

No transportation lines were established during the year.

It is estimated that $2,500 will be required for maintenance of the improvement during the fiscal year ending June 30, 1899.

July 1, 1896, balance unexpended	$2,237.36
June 30, 1897, amount expended during fiscal year	162.59
July 1, 1897, balance unexpended	2,074.77
July 1, 1897, outstanding liabilities	161.21
July 1, 1897, balance available	1,913.56
Amount that can be profitably expended in fiscal year ending June 30, 1899, for maintenance. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	2,500.00

(See Appendix L 5.)

6. *Neuse River, North Carolina.*—When the United States commenced the improvement, in 1878, the minimum channel depth for nine months annually was 9 feet to Newbern, 4 feet to Kinston, 3 feet to Goldsboro, 2 feet to Smithfield. The river was badly obstructed by war and other obstructions.

The approved project of 1871, as modified in 1878, 1879, 1880, 1883, and 1888, is to assure an 8-foot navigation up to Newbern during the entire year, 4 feet to Kinston, and during nine months of the year 3 feet to Smithfield, the work to be done by removing war obstructions, dredging, jettying, and snagging, at a total cost estimated at $374,000.

In 1896 (approved July 15) the project was extended to include maintenance.

Up to the close of the fiscal year ending June 30, 1896, $285,029.29 had been expended upon this improvement.

At that date the ruling depth between Newbern and the mouth of Contentnia Creek, 18 miles below Kinston, was 2.5 feet at low water, and from there to Kinston 1.1 feet. Many of the old jetties were in need of repairs; some had entirely washed away. Between Kinston and the mouth of Contentnia Creek and between Goldsboro and Whitehall there were many snags in the river.

As a result of the work of the fiscal year ending June 30, 1897, by a combination of dredging and jettying the projected depth (4 feet at low water) has been obtained to the mouth of Contentnia Creek (31¼ miles from Newbern), and by jettying the worst shoal between Contentnia Creek and Kinston has been improved. The ruling depth between Contentnia Creek and Kinston is 2 feet.

The river has been cleared of snags from Newbern to the Wilmington and Weldon Railroad Bridge near Goldsboro.

The commerce during 1896 amounted to 297,092¼ tons, a gain of 19,066¾ tons over that of last year.

No transportation lines were established during the year.

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It is estimated that $5,000 will be required annually for maintenance of the improvement, including snagging.

July 1, 1896, balance unexpended	$11,470.71
June 30, 1897, amount expended during fiscal year	9,190.36
July 1, 1897, balance unexpended	2,280.35
July 1, 1897, outstanding liabilities	85.65
July 1, 1897, balance available	2,194.70

Amount (estimated) required for completion of existing project	77,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	20,000.00
Amount required for maintenance and snagging during fiscal year ending June 30, 1899	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix L 6.)

7. Inland waterway between Newbern and Beaufort, N. C. (via Neuse and Clubfoot rivers, Clubfoot and Harlowe Canal, owned by the Albemarle and Chesapeake Canal Company, and Harlowe and Newport rivers to Beaufort Harbor).—When the United States began to improve it, in 1885, that part of the waterway, 18 miles in length, across the peninsula between the Neuse River and Bogue and Core sounds, embracing 15.5 miles of natural channel, connected at the summit by the Clubfoot and Harlowe Canal, was navigated by boats 15 feet wide, with a draft of 1 foot at low water and about 2½ feet at high water.

The project of 1884 is to obtain a channel 30 feet wide at bottom and 5 feet deep at mean low water across the peninsula by dredging in Clubfoot, Newport, and Harlowe rivers, and by improvement of the canal, at a cost estimated in 1886 at $92,000.

To June 30, 1896, $27,914.39 had been spent upon this work.

At that date the cuts dredged by the United States in Harlowe Creek had remained as dredged, but the cut dredged at the mouth of the creek had deteriorated until scarcely a trace of it remained. The least available channel width in Clubfoot Creek and in Harlowe Creek was 25 feet. Some logs were to be encountered in these creeks. Many sunken logs were in the canal. It had narrowed and shoaled, and had a depth of 1.5 feet at ordinary low water and 3 feet at ordinary high water.

There has been no work during fiscal year ending June 30, 1897.

Further work, except maintenance by snagging of a depth equal to that in the canal, has been postponed to await the cession or sale of the canal to the United States. (See Annual Report Chief of Engineers for 1891, p. 161.)

The commerce on this stream during 1896 amounted to about the same as last year, i. e., 29,737 tons.

No transportation lines were established during the year.

July 1, 1896, balance unexpended	$7,085.61
July 1, 1897, balance unexpended	7,085.61

Amount (estimated) required for completion of existing project	57,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L 7.)

8. Harbor at Beaufort, N. C.—When its improvement by the United States (begun in 1836) was resumed in 1881, the erosion of Fort Macon and Shackleford points and widening of the entrance between them caused serious shoaling of the channel inside the bar, across which

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there was a mid-channel depth of not less than 15.3 feet at low water. Within the harbor from the Bulkhead Channel a draft of only 2 feet at low water could be carried to the wharves at Beaufort.

The project of 1881 was to stop the erosion at Fort Macon and Shackleford points by jetties, to dredge a channel 200 feet wide and 9 feet deep at low water from the Bulkhead Channel 1,950 feet to the wharves at Beaufort, and to dredge a channel 100 feet wide and 6 feet deep at mean low water from the 6-foot contour leading to North River, a distance of 12,670 feet.

In 1887 the project was modified by postponing for the present the dredging of the cut through the Old Town Channel to North River, and by reducing to the width of 100 feet and depth of 5 feet the channel to be dredged from the Bulkhead Channel to Beaufort; and in 1890 the project was again modified by increasing the latter dredging to the depth of 7 feet. The cost of executing the project was estimated in 1887 at $163,000.

In 1896 the project was amended so as to include only the building and repair of jetties and sand fences at Fort Macon and Shackleford points to stop erosion.

Up to the close of the fiscal year ending June 30, 1896, $147,845.32 had been expended on this improvement.

At that date the channel leading to the town of Beaufort was in good condition; the channel across the Bulkhead dredged in 1895 had shoaled to about 4 feet at low water. The depth on the main bar was 12 feet at low water.

The work during the fiscal year ending June 30, 1897, has been confined to the maintenance of the sand fences and jetties at the harbor entrance, with the result of some improvement, especially at Shackleford Point, in raising the beach and extending it seaward.

The channels are in the same condition as at the end of the last year. The depth on the bar was 10.5 feet.

The commerce during 1896 amounted to 38,807 tons, a gain since last year of 8,284¾ tons.

No transportation lines were established during the year.

July 1, 1896, balance unexpended	$7,154.68
June 30, 1897, amount expended during fiscal year	1,520.14
July 1, 1897, balance unexpended	5,634.54
July 1, 1897, outstanding liabilities	80.84
July 1, 1897, balance available	5,553.70

(See Appendix L 8.)

9. Inland waterway between Beaufort Harbor and New River, North Carolina.—When the first appropriation was made, in 1886, there were in the 28 miles in Bogue Sound from Beaufort to Swansboro six shoals, aggregating about 4 miles in length, over which not more than 18 inches could be carried at low water. Elsewhere the channel was not less than 3 feet deep. From Swansboro 22 miles to New River the route followed intricate tidal channels, varying from 1,000 to 12 feet in width and 10 feet to 6 inches in depth at ordinary low water.

The project adopted in 1885 embraced only that part of the route from Beaufort to Swansboro, and is to obtain a channel of the minimum depth of 3 feet and width of 100 feet by dredging through all the shoals, at an estimated cost of $50,000.

In 1896 the project was modified to read, "to obtain a channel 60 feet wide and 3 feet deep at mean low water through Bogue Sound."

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To June 30, 1896, $37,100.91 had been expended upon this work.

At that date a channel of the variable widths 40, 60, and 100 feet, and not less than 3 feet deep at low water, had been obtained by dredging through 6 shoals, aggregating 4.12 miles in length; but at two localities, aggregating 1,927 feet, between shoals which had been dredged there was a depth of less than 3 feet, and at the shoalest point of only 2.5 feet at low water.

During the fiscal year ending June 30, 1897, 11,041.90 cubic yards of material was dredged from Sanders Creek Shoal, widening the cut in that shoal 20 feet, making it 60 feet in width and from 3 feet to 4 feet deep at low water.

The commerce during 1896 amounted to 18,022 tons, a loss of 3,852 tons since last year.

No transportation lines were established during the year.

July 1, 1896, balance unexpended	$6,399.09
June 30, 1897, amount expended during fiscal year	5,399.09
July 1, 1897, balance unexpended	1,000.00
Amount (estimated) required for completion of existing project	6,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	6,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix L 9.)

10. New River, North Carolina.—In 1886, when the United States began the improvement, there was around Cedar Bush Marsh, 1½ miles above the mouth, a circuitous channel in which the depth was less than 4 feet on two shoals, and around Wrights Island, 700 yards above the bar, a circuitous channel, but not less than 5 feet deep at mean low water. Except around Cedar Bush Marsh 4 feet could be carried from the ocean, 23 miles, to Jacksonville.

The original project, adopted in 1882, was to straighten, widen to 150 feet, and deepen to 5 feet at mean low water the channel around the marsh by dredging, at an estimated cost of $40,000.

The project of 1885 was to dredge a straight channel 4 feet deep at mean low water, 150 feet wide, and 5,710 feet long, through Cedar Bush Marsh, instead of improving the channel around it; also to dredge a channel 4 feet deep, 150 feet wide (changed in 1892 to 100 feet), and 1,200 feet long, through Wrights Island, to replace the circuitous channel around it.

June 18, 1894, the project was again modified to improve by a training wall, and by dredging the channel around Cedar Bush Marsh, in place of the cut made through the marsh, which had to be abandoned in consequence of shoaling at its upper extremity.

To June 30, 1896, $28,930.63 had been expended on this improvement. The condition of the improvement at that date was that, with the exception of a shoal at the upper entrance to the cut through Wrights Island, which was improving with the closing of the old channel around the island, the projected depth from the ocean to the upper river could be carried.

No field work has been done during the fiscal year ending June 30, 1897; the amount expended was the pro rata charge to this appropriation for repairs to the dredge *Albemarle* and steamer *General George Thom.*

During the year the shoal at Wrights Island Cut has disappeared; the ocean bar has been in fair condition with not less than a 4-foot depth

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on it at low water. Due to deterioration of the training dike, the Cedar Bush Marsh Shoal had formed again, so that the available low-water depth over it was 3 feet.

The commerce on this stream during 1896 amounted to 7,213 tons, a loss of 19,558.75 tons since last year.

No transportation lines were established during the year.

July 1, 1896, balance unexpended	$4,069.37
June 30, 1897, amount expended during fiscal year	569.37
July 1, 1897, balance unexpended	3,500.00

(See Appendix L 10.)

11. North East (Cape Fear) River, North Carolina.—When the United States began to improve it in 1890 a draft of at least 6 feet could be carried up 48 miles to Bannerman's Bridge at lowest stage. From Bannerman's Bridge, 55 miles up to Kornegay's Bridge, the river is so shallow that its navigation is dependent upon freshet stages. Above Bannerman's Bridge it was badly obstructed by snags and overhanging trees.

The project of 1889 is to clear the channel to its natural depth and to a good width for small light-draft steamers up to Hallsville, and for pole boats up to Kornegay's Bridge, at an estimated cost of $30,000.

To the close of the fiscal year ending June 30, 1896, $11,121.67 had been expended.

At that date the river below the 98½ milepost (about 5 miles below Kornegay's Bridge) was so badly obstructed by snags and fallen trees that flatboats could use the river only during the highest freshets.

During the year snags and other obstructions were removed between the 56th and the 98½ mileposts and over a space of 3 miles immediately above Wilmington. In consequence of this work a small steamboat has commenced to make semiweekly trips from Wilmington to Croom's Bridge and to Hallsville weekly, when the stage of water permits.

The commerce during 1896 amounted to 85,163½ tons, a gain of 45,442½ tons over that of last year.

No transportation lines were established during the year.

It is estimated that $2,000 will be required for maintenance of the improvement during the fiscal year ending June 30, 1899.

July 1, 1896, balance unexpended	$3,878.33
March 4, 1897, amount received from sale to Cape Fear River at and below Wilmington	243.33
	4,121.66
June 30, 1897, amount expended during fiscal year	3,553.55
July 1, 1897, balance unexpended	568.11
Amount that can be profitably expended in fiscal year ending June 30, 1899, for maintenance	2,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix L 11.)

12. Black River, North Carolina.—When the United States began to improve this river, in 1887, the channel from the mouth 24 miles to Point Caswell was fairly cleared to a depth not less than 4 feet at low summer stages, and was roughly cleared 62 miles farther to Lisbon, with a least channel depth of 2½ feet at low stage in the 10 miles from Point Caswell to Haws Narrows; thence 52 miles to Lisbon the depth at low

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summer stage was 18 inches to 3 feet on the shoals and 10 to 12 feet in the pools.

The project of 1885, modified in 1892 and 1893, was to apply at least $13,000 to removing logs, snags, and overhanging trees from the bed and banks and rounding off a few of the sharpest bends in the river from its confluence with the Cape Fear up 64 miles to Clear Run.

This project was completed September 20, 1895.

The project of 1894 was the maintenance of the channel up to Clear Run clear of such logs, snags, and overhanging trees as may accumulate to the detriment of navigation.

The project of 1896 is the continuation of that of 1894.

To the close of the fiscal year ending June 30, 1896, $14,662.88 had been expended.

At that date the river had been cleared of snags and overhanging trees from its confluence with the Cape Fear to Clear Run (64 miles).

Navigation was obstructed for several months in each year by shoals, and the river was obstructed by snags and overhanging trees, particularly below the forty-seventh milepost.

During the fiscal year ending June 30, 1897, owing to the limited amount of funds available, work could be attempted only at the worst obstructed places. The snag boat was engaged for one month in this work.

The shoal at Haws Narrows was satisfactorily improved by closing two sloughs with brush and logs.

The available low-water depth was 4 feet from the mouth to Point Caswell, 2½ feet thence to Haws Narrows, and 1½ feet thence to Clear Run.

The commerce during 1896 amounted to 69,033¼ tons, a gain of 5,771¼ tons over that of last year.

No transportation lines were established during the year.

It is estimated that $2,000 will be required for maintenance of the improvement during the fiscal year ending June 30, 1899.

July 1, 1896, balance unexpended	$1,337.12
March 4, 1897, amount received from sale to Cape Fear River, North Carolina, at and below Wilmington	243.34
	1,580.46
June 30, 1897, amount expended during fiscal year	809.63
July 1, 1897, balance unexpended	770.83
July 1, 1897, outstanding liabilities	2.50
July 1, 1897, balance available	768.33
Amount that can be profitably expended in fiscal year ending June 30, 1899, for maintenance. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	2,000.00

(See Appendix L 12.)

13. Cape Fear River above Wilmington, N. C.—When the United States began to improve it, in 1882, a draft of 4 feet could be carried at lowest stages 47 miles above Wilmington to Kellys Cove; thence 68 miles to Fayetteville there were many shoals, on some of which the depth was not more than 12 to 14 inches during the low stage; from Indian Wells Landing, 37 miles above Wilmington, 78 miles to Fayetteville, the river was badly obstructed by snags, logs, and overhanging trees.

The project of 1881, as matured in 1885 and 1886, is to obtain at all

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times of the year a depth of 4 feet from Wilmington 73 miles to Elizabethtown, and of 3 feet thence 42 miles to Fayetteville, by removing snags and rock from the bed and overhanging trees from the banks, by contracting the channel by jetties on the shoals, and by a little dredging at a bar of clay, at a total cost estimated in 1886 at $472,000.

To the close of the fiscal year ending June 30, 1896, $128,991.13 had been expended.

At that date the river was obstructed by many sunken logs and snags from the head of navigation at Fayetteville to the head of tide water at Kellys Cove. Shoals were known to exist at McDowells Barn, 1.8 feet depth; Elizabethtown, 2.7 feet; Little Sugar Loaf, 3 feet, and Walkers Bluff, 2.9 feet. These shoals were improved by the construction of jetties of piles and brush, and the shoals are reported by river pilots as being greatly improved.

The worst obstructions were removed from the channel by the snag boat *H. G. Wright*, and at the end of the year she is at work on the river.

The commerce during 1896 amounted to 99,357½ tons, a loss since last year of 4,369½ tons.

One transportation line was established during the year.

It is estimated that $3,000 will be required annually for maintenance of the improvement, including snagging.

July 1, 1896, balance unexpended	$8,258.87
March 4, 1897, amount received from sale to Cape Fear River at and below Wilmington	243.33
April 30, 1897, amount received from sale to torpedoes for harbor defense	171.00
	8,673.20
June 30, 1897, amount expended during fiscal year	4,241.74
July 1, 1897, balance unexpended	4,431.46
July 1, 1897, outstanding liabilities	687.05
July 1, 1897, balance available	3,744.41

Amount (estimated) required for completion of existing project	137,750.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	18,000.00
Amount required for maintenance and snagging during fiscal year ending June 30, 1899	3,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix L 13.)

14. Cape Fear River at and below Wilmington, N. C.—The United States began to improve the river between the bar and Wilmington in 1829 and the channel on the bar in 1853. In 1829 the river was so obstructed that vessels drawing more than 10 feet were obliged to anchor 14 miles below Wilmington and discharge a part of their cargoes into lighters. In 1853 at low water on the bar the least mid-channel depth was 7 feet in the western channel, 7½ feet in the eastern channel, and 8 feet at New Inlet, 7 miles above the mouth.

The original project of 1827 was to deepen the channel through the shoals in the 8 miles next below Wilmington by contracting it by jetties and by diverting into it water from Brunswick River and from Fishing and Rodmans creeks.

The project of 1853 was to straighten and deepen the channel on the bar by building jetties and a wing dam, by dredging, by diverting water through it from New Inlet, by building a jetty at Federal Point, and by closing two small breaches in Zekes Island.

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The project of 1870 was to deepen the bar channel by closing the breaches between Smiths and Zekes islands, with the ultimate closure of New Inlet in view.

The project of 1873 was to deepen the channel through the bar, added to that of 1870, to dredge in the Baldhead (eastern) Channel, to extend across Zekes Island and beyond it into the river the dam then being built to close the breaches between Smiths and Zekes islands, and to close New Inlet, commencing with the building of a jetty from Federal Point.

The project of 1874 was "to get 12 feet at low water as high as the city of Wilmington" by dredging a channel 100 feet wide through Horseshoe Shoal below New Inlet and through three other shoals near Wilmington.

The project of 1881 was to dredge a channel 2¾ miles in length through Horseshoe Shoal and through eight other shoals above it 270 feet wide and 16 feet deep at mean low water from deep water at Smithville (Southport) to Wilmington.

February 28, 1889, pursuant to a requirement of the river and harbor act of August 11, 1888, the cost of obtaining a channel 20 feet deep at mean low water from Wilmington to the ocean was reported to be $1,800,000. In the Annual Report for 1889 it was reported that an additional appropriation of $25,000 would be required to complete the project of 1881 and obtain a channel 16 feet deep from Wilmington to the ocean. By the river and harbor act of September 19, 1890, Congress appropriated $170,000 for improving the Cape Fear River at and below Wilmington, and dredging to the depth of 20 feet commenced at Wilmington January 19, 1891, and ceased at Brunswick River Shoal, 4½ miles below Wilmington, September 7, 1892.

Since September 7, 1892, work has been in progress to obtain a channel through the shoals between Wilmington and the bar, and on the latter 18 feet deep at mean low water.

The project of 1896 (approved July 29) is to obtain a depth at mean low water of 20 feet and a channel width of 150 feet (of the 270 feet projected in 1889) from Wilmington to the ocean.

Expenditures to June 30, 1896, were $2,597,476.79.

At that date a channel 18 feet deep existed over the bar and in the dredged channels in the river to Wilmington, except at Snows Marsh, where the depth was 16.7 feet. The shoals immediately below Wilmington had been dredged to 20 feet. Navigation in the river was controlled by the depth at Snows Marsh.

The sea had made a breach around the shore end of New Inlet Dam at Federal Point.

The results derived from the expenditures during the year have been that the channel in Snows Marsh has been deepened to 18 feet, and the channel on the bar increased to 20 feet, both at mean low water.

A dredging plant has been purchased and set at work in the river, and the work of dredging the river channel to 20-foot depth commenced. The break at the end of the New Inlet Dam has been permanently repaired.

The commerce during 1896 amounted to 673,208 tons, a gain of 55,154 tons over that of last year.

Two transportation lines were established during the year.

It is estimated that $25,000 will be required annually for maintenance of the improvement where the projected depth and width have been obtained.

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July 1, 1896, balance unexpended	$272,523.21
March 4, 1897, amount received from sale to other appropriations	100.00
May 31, 1897, amount received from rent of scow	15.00
	272,638.21
June 30, 1897, amount expended during fiscal year	99,524.20
July 1, 1897, balance unexpended	173,114.01
July 1, 1897, outstanding liabilities	4,867.47
July 1, 1897, balance available	168,246.54

Amount (estimated) required for completion of existing project	1,035,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	225,000.00
Amount required for maintenance during fiscal year ending June 30, 1899	25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix L 14.)

15. Lockwoods Folly River, North Carolina.—When the United States began this improvement in 1892 the depth on the changeable ocean bar was usually 4 feet at low water and 8 feet at high water. These depths could be carried at low stages 1½ miles up the channel to a mud flat over which for 1½ miles the channel depth averaged less than 1 foot at low water. A little above these flats was a shoal 300 feet long upon which the depth at low water was about 2½ feet; thence to Lockwoods Folly Bridge, about 22 miles by river, the depth was nowhere less than 5 feet at low water.

The project was adopted in 1887 to dredge a channel through the flats 100 feet wide and 7 feet deep at low water.

To June 30, 1896, $17,818.51 had been expended.

At that date there existed an unobstructed channel 40 feet least width and 5 feet least depth from the inlet to Lockwoods Folly Bridge, about 25 miles distant, except at two short shoals one-half of a mile and 1½ miles from the inlet, in which there were, respectively, 3.6 and 4.5 feet depths at low water. These two shoals have the benefit of a 4-foot tide.

The commerce on this stream during 1896 amounted to 2,410 tons, a gain of 247 tons over that of last year.

No transportation lines were established during the year.

There have been no expenditures during the fiscal year ending June 30, 1897.

July 1, 1896, balance unexpended	$181.49
July 1, 1897, balance unexpended	181.49

(See Appendix L 15.)

EXAMINATION AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The preliminary examination and surveys of the following localities, required by the act of June 3, 1896, were made by the local engineers, and reports thereon submitted:

1. Preliminary examination and survey for a jetty near Bogue Inlet, North Carolina, in order to remove sand bars.—The act of June 3, 1896, authorized both a preliminary examination and survey of this locality for the purpose mentioned. Lieut. Col. D. P. Heap, Corps of Engineers, submitted report of examination August 17, 1896, and report of survey February 19, 1897. The plan of improvement presented provides for

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obtaining a mean high-water channel depth of 8 feet from Swansboro to Bogue Inlet by means of jetty construction, supplemented by dredging. The estimated cost is $16,818.75. It is the opinion of the local officer, concurred in by the Chief of Engineers, that the interests involved do not justify the cost of the improvement proposed. The reports were transmitted to Congress and printed in House Doc. No. 316, Fifty-fourth Congress, second session. (See also Appendix L 16.)

2. Survey of Ocracoke Inlet, North Carolina, to obtain a channel 14 feet in depth.—Lieutenant-Colonel Heap submitted report of survey March 8, 1897. The channel depth at the inlet now exceeds 14 feet at high water, and the plan of improvement presented therefor provides for securing at this locality a channel 14 feet deep at mean low water and 500 feet wide along the line where the least amount of dredging would be required. It is estimated that the work necessary to secure such a channel will cost $17,250. Frequent dredging would be required to maintain this depth. The local officer remarks that no special benefit to commerce would accrue from the proposed increased depth until the cuts through Royal Shoal and Beacon Island Slough, which now have a depth of 9 feet at mean low tide, are deepened to 14 feet, and that it would be wiser to deepen these two cuts before undertaking any work of improvement at the inlet. In conclusion, he does not recommend an appropriation toward obtaining a channel 14 feet in depth at mean low water at Ocracoke Inlet. The report was transmitted to Congress and printed in House Doc. No. 7, Fifty-fifth Congress, first session. (See also Appendix L 17.)

3. Survey of Pamlico River, North Carolina, to obtain a depth of 10 feet up to Washington, and to make necessary improvements of the harbor at Washington.—Lieutenant-Colonel Heap submitted report of survey March 9, 1897. This river has been under improvement by the United States since 1877, with the view of securing a depth of 9 feet at low water up to Washington. It is estimated that to secure a channel in the river having a depth of 10 feet and width of 200 feet at mean low water up to Washington would cost $156,040.28; but it is the opinion of the local officer, for reasons stated, that a channel depth of 9 feet and width of 100 feet at mean low water are sufficient at the present time for the requirements of navigation on the Pamlico River. A channel of these latter dimensions extending up to Washington could be obtained at an estimated cost of $39,202, and Lieutenant-Colonel Heap recommends improvement to this extent as worthy of being undertaken by the General Government. He does not consider that the harbor of Washington "needs further improvement at present." The report was transmitted to Congress and printed in House Doc. No. 5, Fifty-fifth Congress, first session. (See also Appendix L 18.)

4. Survey of Neuse River, North Carolina, at and below Newbern, for an 8-foot depth at dead low water.—Lieutenant-Colonel Heap submitted report of survey February 19, 1897. The project of improvement proposed by the local officer provides for the excavation of a channel 8 feet deep at dead low water, with widths of 200 feet at Newbern and 300 feet below that point. The cost is estimated at $59,081.25. The report was transmitted to Congress and printed in House Doc. No. 317, Fifty-fourth Congress, second session. (See also Appendix L 19.)

5. Survey of Cape Lookout harbor of refuge, North Carolina, with a view to making it capable of sheltering the largest vessels.—Capt. W. E. Craighill, Corps of Engineers, submitted report of survey July 6, 1897, through the division engineer, Col. Peter C. Hains, Corps of Engineers. The plan of improvement presented provides for the construc-

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tion of a stone breakwater extending 6,200 feet beyond the shore line and sheltering an area of 540 acres, with 30 feet or more depth of water. The estimated cost of the work is $3,700,000, the unit prices adopted being based upon the assumption that funds will be supplied as fast as they can be economically expended. The work projected is one of great magnitude and cost. The plans now presented can only be considered as general in their nature and preliminary. Should Congress deem it proper to inaugurate the construction of this harbor of refuge, the location and plan in all details must be given further and very full consideration. The report is submitted with the understanding that the plans presented are subject to such modifications as future investigation may show to be desirable. (See Appendix L 20.)

6. Survey of Town Creek, Brunswick County, North Carolina, with a view to straightening the river in at least two places, and to obtain a depth of at least 8 feet to Upper Bridge, and to improve the river 6 miles farther to the head of tide water to a place known as the Rocks, by removing obstructions, etc.—Lieutenant-Colonel Heap submitted report of survey January 16, 1897. Assuming that "a depth of at least 8 feet" refers to mean low water, the local officer estimates that the improvements desired will cost $36,288, but he states that such an outlay is not warranted by the commerce of this creek, present or prospective, nor is the 8-foot depth at mean low water required for the one boat navigating the creek. He reports further, however, that to make a channel 40 feet wide at bottom and 5 feet deep at mean low water from the mouth to Upper Bridge and to snag and remove obstructions from the creek from the mouth to the Rocks, provided that no work be done until Upper Bridge is provided with a proper draw, will satisfy the needs of commerce, and he estimates the cost of this work at $8,500. It is his opinion that the commerce of the creek warrants this improvement. The report was transmitted to Congress and printed in House Doc. No. 214, Fifty-fourth Congress, second session. (See also Appendix L 21.)

IMPROVEMENT OF WACCAMAW AND LUMBER RIVERS, NORTH CAROLINA AND SOUTH CAROLINA, AND OF CERTAIN RIVERS AND HARBORS IN SOUTH CAROLINA.

This district was in the charge of Capt. Frederic V. Abbot, Corps of Engineers, having under his immediate orders Lieut. Edwin R. Stuart, Corps of Engineers, since September 30, 1896. Division Engineer, Col. Peter C Hains, Corps of Engineers.

1. Waccamaw River, North Carolina and South Carolina.—In 1880 this stream was navigable for 12-foot boats at all stages of water from Georgetown 23 miles to Bull Creek, and at high water 4 miles farther to Bucks Lower Mills; thence for 7-foot draft boats, at high water, 22 miles farther to Conway; thence it possessed an obstructed channel for 3-foot draft boats, at ordinary winter water, 68 miles to Reeves Ferry; thence an obstructed channel with 3 feet at high water for 30 miles to Lake Waccamaw.

The project of improvement provides for a channel 12 feet deep at all stages of water with 80 feet bottom width from the mouth of the river to Conway, thence a cleared channel to Lake Waccamaw, at an estimated cost of $138,400.

The original estimated cost was $29,370, which was revised in 1885, and increased in the Annual Report of that year to the present figure, $138,400. In Annual Report for 1886, page 170, maintenance is estimated at $4,000 per year after completion of improvement.

The total expenditure to June 30, 1896, was $93,479.13. At that date

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the river was safely navigable for steamers over the whole improved portion, which extends much farther upstream than formerly. Every season's work increased the length of river actually used by these boats. At eight shoals, jetties made of piles and plank had been put in, and the river had been snagged for a distance of 121 miles above the mouth. Since June 30, 1884, 28,122 obstructions have been removed. Before June 30, 1884, the records are not sufficiently in detail to give exact figures.

During the past year the river was snagged between the mouth and 128 miles above, 2,276 obstructions having been removed. This makes the aggregate number of obstructions removed since June 30, 1884, 30,398. The total expenditures for the corresponding period have been $67,970.69. During the past fiscal year $3,556.74 has been spent and the former improved portion of the river has been kept free of snags and the improvement has been carried 7 miles farther up.

Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1887	.....	$2,129,231.75	1893	70,976	$2,095,548.00
1889	.....	2,308,915.00	1894	99,298	2,120,864.00
1890	67,195	2,317,368.50	1895	128,466	2,063,697.00
1891	76,245	2,231,112.00	1896	203,388	2,314,175.00
1892	83,103	2,178,369.00	1897	241,300	2,406,390.00

July 1, 1896, balance unexpended	$6,420.87
June 30, 1897, amount expended during fiscal year	3,556.74
July 1, 1897, balance unexpended	2,864.13
July 1, 1897, outstanding liabilities	231.39
July 1, 1897, balance available	2,632.74
Amount (estimated) required for completion of existing project	38,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix M 1.)

2. Lumber River, North Carolina and South Carolina.—This river, in its original condition, was obstructed by logs, snags, stumps, overhanging trees, and in places by sand bars. Long reaches were in fair condition. That portion of the river between Lumberton and the North Carolina line was crossed by five low bridges, without drawspans, and one moderately high railroad bridge near Lumberton. In South Carolina the river was crossed by two bridges without draws.

The project provides for improving the river for steamboats from its mouth to Lumberton, a distance of 70.8 miles, by snagging and clearing the banks, at an estimated cost of $35,000.

The total expenditure to June 30, 1896, was $18,294.30. A plant had been built and 21,964 obstructions removed. On June 30, 1896, the river had been roughly cleared of the worst snags from the mouth to Lumberton, 71 miles above, this being the limit of the project. Two small steam launches ran on the river at intervals.

The parties operating the Fair Bluff and Ivy Bluff bridges had provided satisfactory drawspans. The bridges at Griffins and Mathews

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had been discontinued. The Atlantic Coast Line had completed a new steel drawbridge to replace the old composite fixed bridge. The new bridge has a clear opening of over 50 feet.

During the past year the small balance left from the appropriation of August 18, 1894, was spent in running over the river once with a snag boat, removing only the most serious obstructions that had fallen into the river since it was last worked over. During the year 1,128 obstructions have been removed, and a steam snag boat has passed over the whole length of the improved river. From the beginning $19,000 has been spent, and 23,092 obstructions removed, in a period of nine years. The main value of the results secured by the expenditure of money in the past fiscal year is the proof that a steamer can get to Lumberton safely, the amount being too small to do much good to the river as a whole.

Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1891	5,100	$39,600	1895	19,131	$104,150
1892	6,800	52,000	1896	61,650	189,000
1893	7,154	54,550	1897	51,846	151,260
1894	10,550	75,800			

July 1, 1896, balance unexpended	$705.70
June 30, 1897, amount expended during fiscal year	705.70

(See Appendix M 2.)

3. Little Pedee River, South Carolina.—The river in its original condition was much obstructed by snags and overhanging trees, and by ten bridges without draws. In places it was divided into several branches, in none of which was there a good channel.

Under the plan of improvement it is proposed to snag the river and close unnecessary branches, providing for steamboat navigation up to the mouth of Lumber River and pole-boat navigation thence to Little Rock, at an estimated cost of $50,000.

By authority of a letter dated November 12, 1896, from the Chief of Engineers, all operations during the past year have been limited to the part of the river below the mouth of Lumber River. It is recommended that no further work be done above that point, as no appreciable benefit resulted from clearing out the upper part of the river when it was done before.

The total expenditures to June 30, 1896, were $18,216.90. At that date the river had been quite well snagged from the mouth, 65 miles to the mouth of Lumber River, and roughly cleared for pole boats and rafts 48 miles farther to Little Rock. A plant had been built and 16,302 obstructions removed. A line of steamers was running quite regularly on the river.

During the past year $2,297.29 has been spent, and 4,567 obstructions have been removed. From the beginning $20,514.19 has been spent, and 20,869 obstructions have been removed. Some dredging will be needed to develop the full value of this stream. Up to this time other work has been more important, to enable the steamers to run without fear of being snagged. The year's work has put the river into better condition for steam navigation than it has been at all before.

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Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1891	4,614	$52,760	1895	12,438	$117,470
1892	7,115	92,964	1896	17,050	198,500
1893	6,153	101,535	1897	13,162	100,400
1894	8,375	114,600			

July 1, 1896, balance unexpended	$3,783.10
June 30, 1897, amount expended during fiscal year	2,297.29
July 1, 1897, balance unexpended	1,485.81
July 1, 1897, outstanding liabilities	57.00
July 1, 1897, balance available	1,428.81
Amount (estimated) required for completion of existing project	28,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix M 3.)

4. Great Pedee River, South Carolina.—The river in its original condition was dangerously obstructed by logs everywhere. Boats drawing 9 feet of water were able to reach Smith Mills, 52 miles above the mouth. Those drawing 3½ feet could get 54 miles farther up at low water to Little Bluff, or at high water to Cheraw, 172 miles from the mouth.

The project of improvement provides for a thoroughly cleared 9-foot navigation to Smith Mills and a 3½-foot navigation to Cheraw at all stages of water, at an estimated cost of $117,000.

The original project of 1880 contained no estimate of cost. From 1880 to 1886, inclusive, $47,000 was appropriated. In the Annual Report for 1886, page 170, it was estimated that $70,000 in addition to this $47,000 would complete the improvement, and that $5,000 a year would be required for maintenance.

The total expenditure to June 30, 1896, was $94,978.23.

At that date, the river as far up as the Wilmington, Columbia and Augusta Railroad Bridge had been thoroughly snagged and was in good condition for steamers to run by night as well as by day. This bridge is 103 miles above the mouth. The remaining 69 miles to Cheraw, which is the head of the projected improvement, was still in bad condition, although steamers ran as far as Cheraw except when the river was low. A snag boat had been built especially for use on this upper river.

During the past year $4,526.62 has been expended, and 2,637 obstructions have been removed. Since June 30, 1884, $80,661.38 has been spent, and 27,937 obstructions have been removed. Some dredging will be needed to develop the full value of this stream. Up to this time other work has been more important to enable the steamers, tugboats, and schooners to run on the lower river, where the depth is ample, without fear of being snagged. The work of the year has mostly benefited the upper river.

Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1891	62,344	$1,367,330	1895	106,115	$893,430
1892	92,471	1,401,038	1896	229,964	1,325,250
1893	94,661	1,166,874	1897	114,177	1,167,914
1894	91,025	1,169,070			

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July 1, 1896, balance unexpended	$12,521.77
June 30, 1897, amount expended during fiscal year	4,526.62
July 1, 1897, balance unexpended	7,995.15
July 1, 1897, outstanding liabilities	377.36
July 1, 1897, balance available	7,617.79
Amount (estimated) required for completion of existing project	9,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	9,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix M 4.)

5. Mingo Creek, South Carolina.—The creek was much obstructed by snags and overhanging trees and was crossed by one bridge without a draw.

The project provides for improving the creek for steamboats from its mouth to Williams Landing, and for pole boats at high water up to the head of navigation, by snagging and clearing banks, at an estimated cost of $17,000.

The total expenditure to June 30, 1896, was $16,223.86. At that date Mingo Bridge had been provided with a drawspan by the parties owning it. A snag boat had been partly paid for from this appropriation and the portion of the river for which steamboat navigation is projected had been thoroughly snagged and the steamers ran both by night and by day, and at either high or low water. Above the bridge there was need of more work.

During the past year the small balance remaining from the appropriation of August 18, 1894, was expended in removing such new obstructions as gave the steamers running on the creek trouble. The work of the year has been purely maintenance. As Congress has not indicated the intention to maintain this improvement, and as there are no funds on hand at the end of the year, no further reports will be submitted.

Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1891	42,875	$1,048,900	1895	136,957	$1,522,000
1892	55,280	1,185,400	1896	169,125	1,814,450
1893	94,665	1,751,600	1897	192,275	1,732,250
1894	114,375	1,423,000			

July 1, 1896, balance unexpended	$776.14
June 30, 1897, amount expended during fiscal year	776.14

(See Appendix M 5.)

6. Winyah Bay, South Carolina.—This large bay is connected with the ocean by a passage between the shores of North and South islands 2½ miles long, 1 mile wide at the bay, three-fourths of a mile at its gorge, and 1¼ miles wide at the ocean or southeasterly end of North Island. Through the passage, which trends north-northwest and south-southeast, there is a bold channel 36 feet deep at the bay, retaining a depth of not less than 20 feet until about 3,000 feet southerly from the end of North Island and of not less than 15 feet to a point about 1 mile south of the island, where the channel divides into two. One of these two channels, known as the Main Ship Channel, continues 3¼ miles farther through extensive shoals to the 18-foot contour in the ocean. This channel is south-southeast and in alignment with the bold channel through the straits. The other, known as Bottle Channel,

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after flowing about 2,500 feet southeasterly, 1,500 feet easterly, and about 3,000 feet northeasterly, before the improvement commenced reached the 18-foot contour in the ocean at a distance of about 1½ miles in a direction from the point of separation from the Main Ship Channel almost at right angles with the direction of that channel and of the channel through the passage. At mean low water the depth on the crest of the bar was variable in both channels and about 7 to 9 feet in the main channel and 6 to 8 feet in Bottle Channel. The mean range of tide is 3½ feet.

The original project provides for two jetties springing respectively from North and South islands, and converging toward the bar. They are to be constructed of mattress foundation, loaded with a stone superstructure, composed of large riprap. The height of crest of each jetty is to be 6 feet above mean low water. The originally projected length of the north jetty was 10,700 feet, that of the south jetty 17,500 feet. Since the date at which the project was approved the shore lines and curves on the bar have changed so materially as to make it necessary to shift the positions of the jetties somewhat; as the project now stands the authority for such changes, without change in estimate, is given in the letter of the Chief of Engineers, dated April 2, 1897. The depth to be secured is 15 feet at mean low water. The total expenditure to June 30, 1896, was $419,705.10.

To June 30, 1891, the north jetty had been advanced only to about low-water line; June 30, 1892, the end of the jetty was 2,090 feet beyond the low-water line, with its crest 18 inches above mean low water; July 22, 1893, on suspension of work, the jetty had been built to a height of 18 inches above mean low water for a distance of 2,200 feet from shore, and the mattresses had been extended 1,464 feet farther, in which distance the height gradually diminished from 18 inches above mean low water to the thickness, about 2 feet, of the ballast on the mattresses at their extremities.

On June 30, 1895, the jetty had been built to a height of 18 inches above mean low water for a distance of 4,700 feet from the shore end, and the extremity of the mattresses was 6,655 feet from the same point. The low-water line, which was in 1890 570 feet from the initial point of the jetty, was on June 30, 1895, 1,070 feet from that point. Up to the last contract stone was deposited chiefly from a trestle tramway, but under the contract of November 19, 1894, with Friday Bros., it was deposited wholly from floating plant.

During the fiscal year ending June 30, 1896, the Friday Bros. continued work on north jetty, extending that part of it which is 18 inches above low water to a point 5,200 feet, at low water to 5,500 feet, and at a level just above the bottom to 6,655 feet from the shore end. About 5,000 tons of large stone and 3,000 tons of small stone was used. It cost $17,000 in round numbers.

The aggregate material in the jetty so far is as follows: Mattress, 60,401 square yards; stone, 107,735 tons; sheet piling, 194,976 feet, B. M.; oyster shells, 601 cubic yards.

The spur jetties on South Island beach were completed. On the mud dike 21,169 cubic yards of mud was deposited, making its total prism 113,923 cubic yards; 16,404 square yards of sodding was also done. The Bottle Channel deepened to 9 feet during the year, apparently under the action of the partly completed north jetty. On June 3, 1896, this improvement was put on the continuing contract list. After the first of January, 1896, all commerce used the Bottle Channel. Up to that time it had been using the main ship channel.

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On December 15, 1896, orders were issued by the Chief of Engineers to prepare specifications for completing the improvement under continuing contracts. Specifications were prepared and bids opened on March 12, 1897, for completing the mud dike, for constructing jetties, and for constructing a pump dredge.

No work of actual construction was done during the year.

The Bottle Channel, which began to deepen in 1896, has maintained its depth of 9 feet, and in May, 1897, was 625 feet wide at the narrowest point between 9-foot curves, as compared with 100 feet the year before.

Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1891	261,370	$8,071,600	1894	293,822	.....
1892	271,986	.....	1896	171,059	$6,228,350
1893	268,640	.....	1897	149,374	5,817,950

July 1, 1896, balance unexpended		$29,044.90
Amount appropriated by sundry civil act approved June 4, 1897		350,000.00
		379,044.90
June 30, 1897, amount expended during fiscal year		12,183.04
July 1, 1897, balance unexpended		366,861.86
July 1, 1897, outstanding liabilities	$787.19	
July 1, 1897, amount covered by uncompleted contracts	1,335,499.43	
		1,336,286.62
Amount (estimated) required for completion of existing project		1,701,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		450,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix M 6.)

7. Santee River, South Carolina.—This river in its original condition was considerably obstructed at all stages of water by sunken logs and snags. Its bar entrance was narrow, crooked, and shifting, with only about 4 feet of water at low tide. Four steamers and a few vessels were then running upon portions of the river.

The project of 1880 proposed to provide the river with a good outlet through Mosquito Creek to Winyah Bay by deepening and straightening this creek to 50 feet width and 7 feet depth; to secure 7-foot navigation in the river from its mouth 120 miles to Wright Bluff, and thence 5 foot navigation 23 miles farther to its head in the Congaree and Wateree rivers.

The estimated cost was $104,427.40. At the same time the estimated cost of cutting a canal from Estherville plantation to Minim Creek, in lieu of the Mosquito Creek Canal, was $158,000. In the Annual Report for 1887, page 1082, the estimate was increased to $346,500.

The revised project of 1889 provides for leaving the Mosquito Creek Canal, which has been completed 30 feet wide and 3 feet deep, for a timber route, cutting a new canal between Estherville and Minim Creek large enough for river steamers, and snagging the entire river, at an estimated cost of $350,000.

The project of 1889 was submitted to Congress in the Annual Report for that year, page 1184.

The total expenditure to June 30, 1896, was $193,636.19.

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At that date the first cut of the Estherville-Minim Creek Canal was about three-fourths of the way through to the Santee River. The Mosquito Creek Canal was in fair condition, and was much used as a timber route.

During the past year $29,126.23 has been spent and 187,631 cubic yards of material has been excavated, completing the first cut all the way through and redredging wherever shoals were found. Four hundred and twenty-one obstructions were removed from the Santee River. This year's work has made the canal available for commerce, and steamers are already running through it. The river itself is safely navigable at extreme low water.

Attention is invited to the recommendation of the officer in charge for such legislation as will permit the slushing or clearing out of old canals not on United States land, to afford drainage to adjoining plantations now liable to damage from overflow from the Government canal. As a measure of economy the legislation suggested seems advisable, and I concur in Captain Abbot's recommendation.

Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1891	100,255	$2,743,000	1895	117,690	$2,224,800
1892	110,523	2,775,800	1896	134,135	2,204,600
1893	124,182	2,679,800	1897	134,206	2,159,940
1894	115,428	2,375,000			

July 1, 1896, balance unexpended	$54,113.81
June 30, 1897, amount expended during fiscal year	29,126.23
July 1, 1897, balance unexpended	24,987.58
July 1, 1897, outstanding liabilities	1,737.72
July 1, 1897, balance available	23,249.86
Amount (estimated) required for completion of existing project	202,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix M 7.)

8. Wateree River, South Carolina.—In 1882 this stream, in its original condition, had a low-water depth of from 3 to 4 feet from its mouth, 67 miles to Camden. The lower 14 miles was completely blocked at all stages of water by logs, snags, etc., and at moderate stages by the bridges of the South Carolina and the Wilmington, Columbia and Augusta railroads, then without drawspans; thence to Camden navigation was possible, but dangerous, except during high water. Its commerce was practically nothing.

The project of improvement provides for safe and unobstructed 4-foot navigation for steamers from Camden to the mouth, at an estimated cost of $60,000.

Congress has made appropriations for maintenance since the project was completed.

The total expenditure to June 30, 1896, was $64,545.63.

At that date the river had been quite thoroughly snagged between its mouth and Camden, the projected head of navigation. A snagging steamer had been built, and 19,027 obstructions removed. A line of steamers was running irregularly on the river.

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During the past year $2,660.96 has been spent and 774 obstructions have been removed. Since June 30, 1884, $44,371.40 has been spent and 19,801 obstructions have been removed. The river is deep and requires no dredging at any point, but it will require snagging annually, as its banks cave. The channel has been satisfactorily maintained throughout the year.

It is estimated that $6,500 will be required for maintenance of the improvement during the fiscal year ending June 30, 1899.

Commercial statistics

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1891	1,005	$51,210	1895	21,697	$127,565
1892	2,244	86,040	1896	35,002	233,525
1893	6,242	117,729	1897	43,770	202,800
1894	18,075	94,334			

July 1, 1896, balance unexpended	$5,454.37
June 30, 1897, amount expended during fiscal year	2,660.96
July 1, 1897, balance unexpended	2,793.41
July 1, 1897, outstanding liabilities	256.60
July 1, 1897, balance available	2,536.81
Amount that can be profitably expended in fiscal year ending June 30, 1899, for maintenance. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	6,500.00

(See Appendix M 8.)

9. Congaree River, South Carolina.—In 1886 this stream, in its original condition, had a low-water depth of 3 to 4 feet from its mouth to the railroad bridge at Columbia; thence 1 foot low-water depth 2 miles farther to its head. Navigation of the lower 47 miles was blocked at all stages of water by the South Carolina Railroad Bridge, and by sunken logs, snags, and overhanging trees. The navigation of the remaining 2 miles was prevented by swift currents and numerous rock ledges and bowlders. Its commerce was nothing.

The project of improvement proposes to secure a thoroughly cleared 4-foot navigation over the lower 47 miles at all stages of water, and a cleared channel, 100 feet wide, through the shoals above, at an estimated cost of $54,500.

Pursuant to House resolution dated December 15, 1893, a project and estimate was submitted and printed as House Ex. Doc. No. 66 of that session, giving the cost of extending steamboat navigation from Granby to Gervais Street Bridge, Columbia. This document and a letter concerning it is reprinted on pages 1182–1189, Annual Report for 1896. Appended to Captain Abbot's report for 1897 is another paper, prepared by the Columbia Board of Trade, which has important bearing on the question.

The total expenditure to June 30, 1896, was $27,910.43. At that date the river had been thoroughly snagged from the mouth to Granby, 2 miles below Columbia, but no attempt had been made to improve the rapids above Granby. A snagging steamer had been built and 7,151 obstructions had been removed. A line of steamers was running very irregularly on the river.

During the past year $1,411.50 has been spent. The snag boat has

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been repaired and 165 obstructions have been removed. From the beginning $29,321.93 has been spent and 7,316 obstructions have been removed. Some dredging will be needed to develop the full value of this stream and give the projected depth. Up to this time the snagging has been more important, so that steamers might run safely whenever the river was not too low for them to pass over the sand bars.

Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1891	2,401	$47,840	1895	8,993	$45,700
1892	3,686	62,025	1896	18,307	178,900
1893	2,781	71,125	1897	40,857	110,100
1894	7,974	40,760			

July 1, 1896, balance unexpended	$3,089.57
June 30, 1897, amount expended during fiscal year	1,411.50
July 1, 1897, balance unexpended	1,678.07
July 1, 1897, outstanding liabilities	193.25
July 1, 1897, balance available	1,484.82
Amount (estimated) required for completion of existing project	23,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix M 9.)

10. Charleston Harbor, including Mount Pleasant and Sullivan Island shore, South Carolina.—There were originally four channels across the bar, the deepest having about 12 feet depth at low water. Commerce was then using the Pumpkin Hill Channel, about 3 miles south of the present jetty channel. Where the present jetty channel is situated, there was then the swash channel, with a best depth of 10½ feet of water, too crooked for safe use. The natural channels were shifting in position and variable in depth.

In 1878 it was proposed to establish and maintain, by means of two jetties and auxiliary dredging, a low-water channel of not less than 21 feet depth across the bar. The swash channel was selected for improvement. The estimated cost was $3,000,000.

In 1888 it became necessary to modify the height of the crest line of the jetties and to revise the estimate. This increase in the estimate was largely due to the fact that money had been appropriated so slowly that reasonable contract prices could not be obtained. The annual appropriation up to that time had been only 5½ per cent of the original estimate. In the revised project the jetties were increased in height and length, but no change was made in their position or distance apart. The revised estimates were $4,380,500 if the jetties were brought up to low-water level throughout, and $5,334,500 if brought up 3 feet higher.

The total expenditure to June 30, 1896, was $3,906,869.78. At that time the jetties were completed, a safe channel 18 feet deep and with a central depth of 18½ feet at low water was available for commerce, and $217,638.49 was available for maintenance.

During the past year the dredge *Charleston* has continued work. A small amount of additional stone has been deposited to reinforce the inner end of the north jetty and to check erosion of the Sullivan Island beach in the vicinity. There has been a gain of three-fourths of a foot in depth at the entrance and of over 2 feet in depth across

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the inner shoals. There remains only a distance of about 700 feet on which the full projected depth of 21 feet at low water has not been obtained.

Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1889	2,192,975	$76,073,600	1893	3,088,951	$78,808,790
1890	2,570,551	90,009,500	1894	2,798,520	75,474,250
1891	2,823,315	95,003,358	1895	3,019,898	70,247,003
1892	2,664,954	86,985,196	1896	3,317,497	79,325,016

July 1, 1896, balance unexpended		$220,630.22
June 30, 1897, amount expended during fiscal year		39,993.52
July 1, 1897, balance unexpended		180,636.70
July 1, 1897, outstanding liabilities	$6,560.00	
July 1, 1897, amount covered by uncompleted contracts	4,240.00	
		10,800.00
July 1, 1897, balance available		169,836.70

(See Appendix M 10.)

11. Wappoo Cut, South Carolina.—Wappoo Cut, in its original condition, was a narrow, crooked tidal stream with not over 2 feet depth in some places. It connects Ashley and Stono rivers.

The original project provided for straightening, widening, and deepening, so that the finished channel should be 6 feet deep and 90 feet wide at low water. Jetties at the Ashley and Stono entrances and light bulkheads across three tidal tributaries were to be built. The estimated cost was $34,000.

This project was modified in the Annual Report of the Chief of Engineers for 1889, page 1196, to provide for a 60-foot width of channel, for a solid cut through the marsh, and for a wider and deeper cut through the Ashley River Bar, at a total cost of $88,000.

The total expenditure to June 30, 1896, was $58,500.71. At that time there was a good 5½-foot channel of sufficient width all the way through.

During the past fiscal year a small amount of dredging was done in the Stono River end of Elliott Cut, and an advantageous agreement was made for placing some additional stone on the revetment of Elliott Cut. The depth in the cut has been maintained throughout the year except at one point, where there is a depth of 5 feet.

Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1891	140,000	$1,976,000	1894	238,350	$1,683,000
1892	.....	1,997,500	1895	250,230	2,260,100
1893	142,800	1,865,500	1896	271,800	2,410,000

July 1, 1896, balance unexpended	$3,999.29
June 30, 1897, amount expended during fiscal year	1,628.76
July 1, 1897, balance unexpended	2,370.53
Amount (estimated) required for completion of existing project	25,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	25,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix M 11.)

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12. Beaufort River, South Carolina.—There was originally a thoroughly good 7-foot channel between the town of Beaufort and Coosaw River, except at a point called Brickyard, near the Coosaw mouth. The least depth here was about 4 feet at low water, and the channel, when deep enough, was too narrow.

The plan of improvement proposed was to deepen and widen the channel by dredging to give a continuous, sufficiently wide, 7-foot channel at low water all the way through. The estimated cost was $25,000. A layer of rock having been encountered at a higher level than was found by the preliminary borings, the work could not be completed for the amount of the original estimate. On April 15, 1893, authority was obtained to increase the estimate to $40,000.

The total expenditure to June 30, 1896, was $25,294.20, securing a 7-foot channel all the way through, but it was much too narrow for convenient use at the point where the rock was encountered.

During the past year about 3,500 cubic yards of rock was removed. The channel is now about 100 feet wide at this point. The result of the dredging has been of great advantage to commerce in the way of safety, but to derive the full value of the improvement elsewhere the cut in the rocky portion must be made wider.

Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1891	202,235	$1,378,800	1894	193,985	$950,000
1892	250,000	1,505,000	1895	174,300	919,750
1893	215,000	1,181,000	1896	100,267	588,000

July 1, 1896, balance unexpended	$5,705.80
June 30, 1897, amount expended during fiscal year	5,134.16
July 1, 1897, balance unexpended	571.64
Amount (estimated) required for completion of existing project	9,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	9,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix M 12.)

IMPROVEMENT OF RIVERS AND HARBORS IN EASTERN GEORGIA.

This district was in the charge of Capt. O. M. Carter, Corps of Engineers. Division Engineer, Col. Peter C. Hains, Corps of Engineers.

1. Savannah Harbor, Georgia.—In 1873, prior to improvement, the channel was in places not more than 9 feet deep at mean low water, and the usual draft of vessels navigating the harbor at high water was 14½ feet.

The original plan of improvement is dated August 28, 1873, and was supplemented March 19, 1879; it contemplates the establishment of a channel from the city to the sea practicable at high tide for vessels drawing 22 feet of water, and its cost was estimated at $481,320. This project was replaced by an enlarged one (January 16, 1882, Annual Report of the Chief of Engineers for 1882, Appendix J 4) contemplating the same channel depth, the cost being estimated at $1,212,000, including former appropriations.

In 1887, in obedience to an act of Congress approved August 5, 1886, a project with estimate of cost of improvement for obtaining 28 feet of water from the city of Savannah to the sea was submitted and is out-

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lined in Appendix N 1, Annual Report of the Chief of Engineers for 1888.

On June 30, 1890, a new project was submitted providing for a mean high-water depth of 26 feet from the city to the sea. This project, which is printed as part of Appendix O, Report of the Chief of Engineers for 1890, was adopted July 22, 1890, its estimated cost being $3,500,000, exclusive of former appropriations. The work contemplated by it was reported practically completed at the end of the fiscal year of 1896, and during the fiscal year just closed only repair work and a small amount of dredging were carried on in accordance with it.

In compliance with requirements of the river and harbor act of August 18, 1894, a modified plan of improvement was submitted December 7, 1894, providing for a detached extension of the Oyster Bed training wall, for the purpose of sheltering the anchorage in Tybee Roads, as well as for protecting the ship channel over the outer part of Tybee Knoll against the destructive action of heavy storms. This project, which is printed as part of Appendix M 1, Annual Report of the Chief of Engineers for 1895, was authorized by law on June 3, 1896, its estimated cost being $992,250.

The entire amount expended on the improvement of Savannah Harbor from its commencement to June 30, 1896, including all outstanding liabilities, was $5,337,611.58.

The amount expended under the project of 1890 up to June 30, 1896, including all outstanding liabilities, was $3,462,549.99, and had resulted in removing from the channel by dredging 5,893,722.06 cubic yards of material, and in placing in the work 1,435,751.21 square yards of log and brush mattresses, 263,019.12 cubic yards of brush fascines, 157,347.32 cubic yards of riprap stone, 13,165 piles, and aside from these 727½ groups of tie piles, 55½ clusters of fender piles; also 704,972.6 feet B. M., of 6 by 10-inch timber and 76,556.78 pounds of iron bolts. There had been put up by special authority 31 day marks marking the dredged channel from Marsh Island to Tybee Knoll. A number of wrecks, old crib obstructions, and wing dams projecting too far into the channel had been removed by the snag boats *Toccoa* and *Satilla*. The erection of day marks and the removal of obstructions had been done by hired labor and purchase of material in the open market.

A steam hoister for use upon the rivers and in Savannah Harbor had been constructed by hired labor and purchase of material in open market.

At the end of the fiscal year 1896 all of the dams and jetties from the lower end of Marsh Island down to the sea were in comparatively good condition, and there was reported between the same two points a continuous channel of not less than 26 feet depth at mean high water, with a least width of 240 feet. Vessels drawing from 23 to 24 feet now enter and leave this harbor on an ordinary high water.

The river and harbor act approved June 3, 1896, contained an appropriation of $5,000 for continuing the improvement of Savannah Harbor, with the following provisions:

Provided, That contracts may be entered into by the Secretary of War for such materials and work as may be necessary to complete the project of further improvement recommended by Captain O. M. Carter in his reports of December 7, 1894, and July 1, 1895, and to complete the project for the steamboat channel between Beaufort, S. C., and Savannah, Ga., recommended by Captain O. M. Carter in his report of December 4, 1895, and mentioned in that report as route No. 2; to be paid for as appropriations may from time to time be made by law, not to exceed the amount of $1,000,000, exclusive of amount herein or heretofore appropriated.

The expenditures authorized are $93,950 less than the estimated cost of both works.

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Under the provisions of this act a contract was entered into for all of the dredging and jetty work required for the improvement at Tybee Roads and in the steamboat channel between Beaufort and Savannah.

During the fiscal year just closed there were used on the detached extension of the Oyster Bed training wall, in the Cockspur training wall, and in Dam No. 31, 218,320.42 square yards of brush mattresses and 17,710.69 cubic yards of fourth-class stone.

In repairing the Jones and the Elba Island spur dams and the Garden Bank training wall there were driven 104 piles, making 420 linear feet of dams; and 11,850 feet B. M., sawed timber, and 1,632.7 pounds of iron bolts were used, and 16⅔ clusters of fender piles were driven. Besides the foregoing, 79 piles were driven as guides.

There was removed by dredging between the old waterworks and the sea, under the contract of October 20, 1892, with P. Sanford Ross, 143,641.41 cubic yards of material, making the entire amount of material excavated in the harbor of Savannah, under the project of 1890, 6,037,363.46 cubic yards.

There was removed by dredging in Wrights River and Ramshorn Creek 133,698.3 cubic yards of material, under the contract of October 6, 1896, with Rittenhouse R. Moore.

The channel depth contemplated by the project was reported as attained at the last fiscal year and has been maintained during the fiscal year just ended, but provision should be made for its continued maintenance by appropriating a sum annually for dredging. Aside from this, the silting up of those portions of the river lying outside of the training walls and the reduction of the size of the river incident thereon, call for further excavation between the training walls. A full discussion of these matters will be found in Captain Carter's annual report for 1896 and for this year.

In 1872 the tonnage of vessels arriving and clearing at Savannah Harbor was somewhat more than 1,000,000; the total value of imports and exports about $34,000,000. Cotton, lumber, wool, hides, naval stores, and rice were principally dealt in. In 1890 the total tonnage had increased to about 2,000,000, and the value of imports and exports to $152,000,000. Besides the articles named above, fruit, produce, and iron were handled extensively. In the year ending June 30, 1897, the total tonnage was about 2,000,000, and the value of imports and exports about $145,000,000, the decrease being due to the general depression of trade.

It is estimated that $100,000 will be required to maintain the improvement during the fiscal year ending June 30, 1899.

July 1, 1896, balance unexpended	$49,485.06
Amount appropriated by sundry civil act approved June 4, 1897	350,000.00
	399,485.06
June 30, 1897, amount expended during fiscal year	33,702.17
July 1, 1897, balance unexpended	[1] 365,782.89
July 1, 1897, outstanding liabilities	[1] 275,478.62
July 1, 1897, amount covered by uncompleted contracts	[2] 724,010.43
Amount (estimated) required for completion of existing project	793,950.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	450,000.00
Amount required for maintenance in fiscal year ending June 30, 1899	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix N 1.)

[1] The sum of $275,478.62 is to be paid on account of outstanding liabilities, leaving a balance of $90,304.27 available.

[2] This work is carried on under continuing contract.

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2. Savannah River, Georgia.—The Savannah River is formed by the junction of the Tugaloo and Keowee rivers and flows in a southeasterly direction to the sea.

A detailed description of the river is found in Captain Carter's report of the examination and survey of the portion above Augusta, printed as House Ex. Doc. No. 213, Fifty-first Congress, first session, and in the report of the survey of the river between Augusta and Savannah, dated June 30, 1890, and printed in Appendix O 2, Annual Report of the Chief of Engineers for 1890, pages 1328–1363.

For the greater part of the year the river is navigable for steamboats drawing from 4 to 5 feet of water, but during the low-water season there are various shoals in the upper part of the river with low-water depths of not more than about 3 feet. The chief obstruction to navigation consists of sand and gravel bars, overhanging trees, snags, and sunken logs.

The original plan for improving Savannah River was submitted in 1880, and is given in Appendix J of the Annual Report of the Chief of Engineers for 1881.

The revised plan of improvement, as outlined in Captain Carter's report of June 30, 1890, provides for the establishment of a navigable steamboat channel 5 feet deep at ordinary summer low water between the cities of Augusta and Savannah.

This is to be accomplished by (1) removing sand and gravel bars; (2) regulating portions of the river, revetting caving banks, and closing incipient cut-offs; (3) removing snags and logs from the channel and overhanging trees from the banks of the stream.

The cost of the improvement as given in the project of 1890 is estimated, in round numbers, at $332,000, provided funds are regularly and adequately supplied.

From $3,000 to $5,000 will be required for the annual maintenance of the completed work.

The entire amount expended on the improvement of Savannah River from its commencement in 1880 to June 30, 1896, including all outstanding liabilities, was $168,500.

The total amount expended under the present project to June 30, 1896, was $75,019.91, and resulted in removing 2,357 snags and stumps, 14,442 overhanging trees, and 1 wreck; 1 tree was girdled, 169 logs were cut up on bank, 3,785.14 cubic yards of material was dredged from the channel, and 746½ pounds of explosives was used. At Canoe Cut Bar there were built 26 spur dams, contracting the channel and protecting the banks, and below the city of Augusta there were built for the protection of the banks 42 spur dams, and some old dams were repaired. The spur dams below the city of Augusta were built by contract; all the other work was done by hired labor and purchase of material in open market. For a special history of early work see page 1029 of the Annual Report of the Chief of Engineers for 1888, and the Annual Reports of the same officer since that date.

At the end of the fiscal year 1896 the channel from Savannah to Augusta was in fair condition, some snags requiring removal.

The total amount expended during the fiscal year just closed, including all outstanding liabilities, was $6,587.23, and has resulted in removing 1,615 snags and stumps, 987 overhanging trees, 100 cubic yards of rock, and 5 wrecks; 38 trees were girdled, 59 logs were cut up on bank, and 346 pounds of explosives was used. At the end of the fiscal year just closed the channel from Savannah to Augusta was in fair condition.

Prior to improvement and after the close of the civil war the com-

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merce of the river was unimportant. Since then it has increased at the rate of about $10 for every dollar expended by the United States, and the freight rates have been reduced about 20 per cent. The exports from the river valley are mainly cotton, naval stores, lumber, and wood, while the imports are fertilizers, camp and mill supplies, cotton ties and bagging, and manufactured articles. Including logs, timber, and cord wood the annual tonnage is estimated at about 75,000 tons, and its value at about $3,500,000.

July 1, 1896, balance unexpended	$15,000.00
June 30, 1897, amount expended during fiscal year	6,377.23
July 1, 1897, balance unexpended	8,622.77
July 1, 1897, outstanding liabilities	210.00
July 1, 1897, balance available	8,412.77
Amount (estimated) required for completion of existing project	270,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix N 2.)

3. Savannah River above Augusta, Ga.—The Savannah River is formed by the junction of the Tugaloo and Keowee rivers, and flows in a southeasterly direction to the sea. Above the city of Augusta the river is navigable only by pole boats.

A detailed description of this river is given in Captain Carter's report of the preliminary examination and survey, printed as House Ex. Doc. No. 213, Fifty-first Congress, first session.

The Savannah River above the city of Augusta has a very steep slope, and the obstacles to navigation are not only very numerous and extensive, but at places quite dangerous. They consist of rock ledges, isolated bowlders, and bars of sand and gravel, with minimum low-water depths of less than 1 foot.

The original plan for improving the Savannah River above Augusta was submitted in 1879, and is given in Appendix I of the Annual Report of the Chief of Engineers for 1879.

The revised plan of improvement, as outlined in Captain Carter's report of January 31, 1890, provides for the establishment between Petersburg and the Locks of a downstream channel 12 to 25 feet in width and navigable during ordinary summer low water (or from nine to ten months of every year) for pole boats drawing 2 feet, and of an upstream channel navigable under the same conditions for pole boats drawing 1.3 feet of water. This is to be obtained by (1) removing logs and overhanging trees; (2) excavating rock, sand, or gravel, and with excavated materials raising crests of ledges; (3) constructing training walls to increase flow of water through sluices. The cost of improvement is estimated at $23,000, provided the money is all made available at once, or at $33,000 if supplied in smaller amounts.

The entire amount expended on the improvement of Savannah River above Augusta from the commencement in 1880 to June 30, 1896, including all outstanding liabilities, was $54,544.52.

The total amount expended under the present project up to June 30, 1896, including all outstanding liabilities, was $15,544.52, and resulted in the repair of old dams and the construction of 3,655 linear feet of new ones. In these dams there were used 3,250.39 square yards of brush mattresses, 2,343.66 cubic yards of brush fascines, and 2,958.30 cubic yards of riprap stone. There were removed from the channel 16

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snags and stumps, 140 overhanging trees, and 804.50 cubic yards of rock; 48 miles of river bank was cleared. At the end of the fiscal year 1896 the works of improvement were in fair condition, and there was a fair navigable channel from the Locks to Petersburg. For a special history of early work, see page 1032 of the Annual Report of the Chief of Engineers for 1888.

The total amount expended during the fiscal year just closed, including all outstanding liabilities, was $226.39, and has resulted in the removal of 6 cubic yards of rock and in the repairing of old dams, in which work 30 cubic yards of riprap stone was used. At the end of the fiscal year just closed the works of improvement were in good condition and the channel fairly so, a number of snags lodged in it by freshets requiring removal.

In 1876–77 about 2,000 tons of freight went upstream from Augusta and about 12,000 bales of cotton came down. In the report of 1888 the down-going freight was estimated at about 5,000 bales of cotton, and in 1896 the total freight carried on the river was valued at about $350,000, and was stated to consist principally of cotton, grain, fertilizers, and general merchandise.

July 1, 1896, balance unexpended	$3,455.48
June 30, 1897, amount expended during fiscal year	226.39
July 1, 1897, balance unexpended	3,229.09
Amount (estimated) required for completion of existing project	14,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	14,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix N 3.)

4. Darien Harbor, Georgia.—About 12 miles above the town of Darien the Altamaha River divides into several branches. The northerly main branch forms the Darien River. That portion of Darien River between Darien and Doboy Sound is known as Darien Harbor.

Darien Harbor in its original condition was more or less obstructed at seven points by shoals, on which were found minimum mean low-water depths of from 6.4 to 10.6 feet. The shoals covered a total distance of 9.7 miles. The reaches between the shoals carried depths nowhere less than 12 feet at mean low water. The mean rise and fall of tide in the harbor is about 6.5 feet.

Operations for improving this harbor have been carried on in accordance with a project of improvement submitted to the Chief of Engineers by General Gillmore, the officer then in charge, dated January 30, 1885, as printed in Appendix N 16, Annual Report of the Chief of Engineers for 1885. It contemplates the establishment of a navigable channel 12 feet deep at mean low water between Darien and Doboy. The estimated cost of the improvement is $170,000. No work was done under the existing project prior to the fiscal year ending June 30, 1891.

The entire amount expended on the improvement of Darien Harbor from its commencement in 1878, when, by act of Congress of June 18, 1878, the sum of $8,000 was appropriated for dredging, including all outstanding liabilities, was $83,000, to June 30, 1896.

The total expenditures under the present project of improvement to June 30, 1896, including all outstanding liabilities, amounted to $75,000, and resulted in the removal by dredging of 86,640.2 cubic yards of material from various shoals and in the construction of 24 spur dams, of an aggregate length of 5,585.6 feet. At the end of the fiscal year 1896 the channel and works of improvement were in fair condition.

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The total amount expended during the fiscal year just closed, including all outstanding liabilities, was $20,000, and has resulted in excavating from the channel 117,143.8 cubic yards of material.

At the end of the fiscal year there was a practicable channel of 11½ feet least depth at mean low water throughout the harbor, excepting at Shoal No. 1, where no work had been done and where the channel depth is only 9½ feet.

The ingoing and outgoing tonnage for 1878 was estimated at about 200,000, and the value of the exports at between $600,000 and $700,000. In 1896 the total annual trade was estimated at about 125,000 tons, valued at $1,500,000, not including a large amount of timber passing through Darien Harbor.

July 1, 1896, balance unexpended	$20,000.00
June 30, 1897, amount expended during fiscal year	19,883.59
July 1, 1897, balance unexpended	116.41
July 1, 1897, outstanding liabilities	116.41
Amount (estimated) required for completion of existing project	75,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	75,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix N 4.)

5. Altamaha River, Georgia.—The Altamaha River is formed by the junction of the Oconee and Ocmulgee rivers in the southeastern part of Georgia and flows in a southeasterly direction to the sea.

A detailed description of this river is given in Captain Carter's report of a survey, dated June 12, 1890, which is printed as part of Appendix O, Annual Report of the Chief of Engineers for 1890, pages 1327–1386.

The chief obstruction to the navigation of the Altamaha River consists in rock ledges, sand bars, overhanging trees, snags, and sunken logs. The rock ledges were confined to the upper portion of the stream, while the other obstructions were found throughout its entire course. The low-water depths at some points did not exceed 1 foot.

The original plan for improving the Altamaha River was submitted in 1880, and is given in Appendix J of the Annual Report of the Chief of Engineers for 1881.

The revised plan of improvement, outlined in Captain Carter's report of June 12, 1890, provides for the establishment of a navigable steamboat channel, 3 feet deep at ordinary summer low water, between the junction of the Oconee and Ocmulgee rivers and the town of Darien.

This is to be accomplished by (1) removing rock shoals and sand bars; (2) building deflecting dikes and closing incipient cut-offs; (3) removing snags and logs from the channel and overhanging trees from the banks of the stream; (4) revetting caving banks.

The cost of the improvement as given in the project of 1890 is estimated, in round numbers, at $129,000, provided funds are regularly and adequately supplied.

From $3,000 to $5,000 will be required for the annual maintenance of the completed work.

The entire amount expended on the improvement of Altamaha River from its commencement in 1881 to June 30, 1896, including all outstanding liabilities, was $105,000.

The total amount expended under the present project to June 30, 1896, including all outstanding liabilities, amounted to $40,223.41, and resulted in removing 1,083 snags and stumps and 7,324 overhanging trees.

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Thirty-one logs were cut upon bank. The snag boat also removed the wreck of the steamer *Tar Heel*, which was lying in the channel at Oswells Cut. At Town Bluff Shoal 45 cubic yards of rock was removed from the channel.

At Beards Bluff 3,246 linear feet of wattled pile dam and 224 linear feet of bank protection were built, and at Marrowbone Bar 79 linear feet of shore protection. All this work was done by hired labor and purchase of material in open market.

There were constructed at Couper Bar a training wall and three spur dams, aggregating 932 feet in length. This work was done by contract.

For a history of early work see page 1246 of the Annual Report of the Chief of Engineers for 1889 and the annual reports of the same officers since that date.

At the end of the fiscal year 1896 the works of improvement were in good condition; the channel depth at Beards Bluff and Marrowbone Bar, so far as known, had maintained itself at 4½ and 5½ feet, respectively.

The total amount expended during the fiscal year just closed, including all outstanding liabilities, was $4,251.32, and has resulted in the removal of 85 snags and stumps, 153 overhanging trees, and 2½ cubic yards of rock; 78 trees were girdled and 19 logs were cut up on bank.

At the end of the fiscal year the works of improvement were in good condition and the channel fairly so, a number of snags lodged in it by freshets requiring removal. At Couper Bar the channel along the training wall has deepened to 2.3 feet.

The commerce of the river before the improvement was begun amounted to about 100,000 tons annually, valued at about $1,000,000. For 1896 it was estimated at 332,000 tons, valued at $4,000,000.

July 1, 1896, balance unexpended	$10,000.00
June 30, 1897, amount expended during fiscal year	4,251.32
July 1, 1897, balance unexpended	5,748.68

Amount (estimated) required for completion of existing project	107,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix N 5.)

6. Oconee River, Georgia.—The Oconee River rises in the northeastern part of Georgia, flows in a southeasterly direction, and unites with the Ocmulgee to form the Altamaha. A detailed description of this river is given in the report of the preliminary examination and survey, printed as House Ex. Doc. No. 211, Fifty-first Congress, first session.

For the greater part of the year the river is navigable for steamboats drawing from 3 to 4 feet, but during the low-water season there are various shoals with low-water depths of not more than 2 feet. The chief obstructions to navigation consist of sand bars, rock shoals, overhanging trees, snags, and sunken logs.

The original plan for improving the Oconee River was submitted in 1875, and is given in the Annual Report of the Chief of Engineers for that year. That plan was modified in 1878, 1880, and 1888.

The present plan of improvement, outlined in Captain Carter's report of February 5, 1890, provides for the establishment of a navigable steamboat channel 3 feet deep at ordinary summer low water from Milledgeville to the river's mouth.

This is to be accomplished by (1) removing rafts, rock shoals, and sand bars; (2) enlarging portions of the river, revetting caving banks, and

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closing incipient cut-offs; (3) removing snags and logs from the channel and overhanging trees from the banks of the stream.

The cost of the improvement is estimated at $171,000, provided funds are regularly and adequately supplied.

From $1,000 to $5,000 will be required for annual maintenance of the completed work.

The entire amount expended on the improvement of Oconee River from its commencement in 1878 to June 30, 1896, including all outstanding liabilities, was $105,000.

The total amount expended under the present project to June 30, 1896, including all outstanding liabilities, was $60,201.43, and had resulted in the removal of 12,343 snags and stumps, 27,839 overhanging trees, 366.5 cords of driftwood, 103 cubic yards of rock and stone, and 266.67 cubic yards of clay and gravel; 900 logs were cut up on bank, 252 trees were girdled, and 600 cubic yards of rock was quarried and put into a dam at Fish Trap Cut. At Old Boat Yard 8 spur dams, aggregating 935 feet in length, were built.

For a special history of early work, see page 1253 of the Annual Report of the Chief of Engineers for 1889.

At the end of the fiscal year of 1896 the jetties at Old Boat Yard were in good condition and a fairly good channel was maintained from the mouth to Milledgeville.

The total amount expended during the fiscal year just closed, including all outstanding liabilities, was $4,628.58, and has resulted in the removal of 75 snags and stumps, 187 overhanging trees, and 100 cubic yards of rock; 50 logs were cut up on bank.

At the end of the fiscal year the channel was in fair condition; a number of snags having become lodged in it require removal.

No reliable statistics of the commerce of the river before the improvement was begun are available. From 1880 to 1885 the information at hand only mentions cotton, guano, rosin, spirits of turpentine, and merchandise, all of these in considerable quantities. In 1895 the tonnage of freight was 119,765 and its value $1,687,875.

July 1, 1896, balance unexpended	$10,000.00
June 30, 1897, amount expended during fiscal year	4,628.58
July 1, 1897, balance unexpended	5,371.42
Amount (estimated) required for completion of existing project	122,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix N 6.)

7. Ocmulgee River, Georgia.—The Ocmulgee River is formed by the junction of the South and Yellow rivers, about 20 miles below Covington, and flows thence in a southeasterly direction about 250 miles, where it unites with the Oconee to form the Altamaha. A detailed description of this river is found in the report of the preliminary examination and survey, printed as House Ex. Doc. No. 215, Fifty-first Congress, first session.

For the greater part of the year the river is navigable for steamboats drawing from 3 to 4 feet, but during the low-water season there are various shoals with depths of not more than 2 feet. The chief obstructions to navigation consist of rock shoals, sand bars, overhanging trees, snags, and sunken logs.

The original plan for improving Ocmulgee River was submitted in 1876, and is given in the Annual Report of the Chief of Engineers for that year. That project was revised in 1882 and again in 1886.

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The present plan of improvement, outlined in Captain Carter's report of February 5, 1890, provides for the establishment of a navigable steamboat channel 3 feet deep at ordinary summer low water from Macon to the river's mouth.

This is to be obtained by (1) removing rock shoals and sand bars; (2) closing incipient cut-offs and revetting caving banks; (3) removing snags and logs from the channel and overhanging trees from the banks of the stream.

The cost of the improvement, as given in the project of 1890, is estimated at $210,000, provided funds are regularly and adequately supplied.

From $1,000 to $5,000 will be required for the annual maintenance of the completed work.

The entire amount expended on the improvement of Ocmulgee River from its commencement in 1876 to June 30, 1896, including all outstanding liabilities, was $144,500.

The total amount expended under the present project to June 30, 1896, including all outstanding liabilities, was $65,244.95, and had resulted in the removal of 8,069 snags and stumps, 28,252 overhanging trees, 1,216 cubic yards of rock and stone, and 4 wrecks; 1,192 trees had been girdled and 351 logs cut up on bank. At Tillmans Bar 12 spur dams and 278 linear feet of crib bank protection were built; 2 snag dams were built at Ashley Landing and 1 snag dam at Indian Timber Landing. For a detailed history of early work, see page 1258 of the Annual Report of the Chief of Engineers for 1889 and the annual reports of the same officer since that date. At the end of the fiscal year of 1896 the channel from the mouth to Macon was in good condition. The total amount expended during the fiscal year just closed, including all outstanding liabilities, is $5,475.24, and has resulted in the removal of 205 snags and stumps, 1,218 overhanging trees, and 548 cubic yards of rock and stone; 1 tree was girdled and 43 logs were cut up on bank.

When work was stopped the channel was in good condition; a number of snags, which have since then lodged in it, require removal.

The expenditures during the fiscal year ending June 30, 1896, resulted in opening a channel through the rocky shoals below Hawkinsville and in maintaining the existing channel from the mouth to Macon.

No available statistics of the commerce of the river before the improvement was begun are available. It is stated in 1889 to have consisted principally of naval stores, cotton, merchandise, camp supplies, etc., and also of timber rafted down the river. In 1887–88 about 14,300 barrels of turpentine and 50,700 barrels of rosin are stated to have been shipped, while probably $300,000 worth of timber was rafted down the river. In 1896 the tonnage was estimated at 120,000 tons, valued at $2,000,000.

July 1, 1896, balance unexpended	$10,000.00
June 30, 1897, amount expended during fiscal year	5,475.24
July 1, 1897, balance unexpended	4,524.76
Amount (estimated) required for completion of existing project	156,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix N 7.)

8. Brunswick Harbor, Georgia.—About 2 miles above the city of Brunswick Turtle River is divided by Buzzard Island into two branches, the smaller one, flowing to the eastward of the island and upon which

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the city of Brunswick is situated, being known as East River, the other retaining the name of Turtle River. These streams unite again about 1½ miles below the city to form Brunswick River. The lower part of East River forms what is known as the harbor of Brunswick.

Turtle and Brunswick rivers have low-water depths of from 4 to 6 fathoms. Over the shoal in East River in front of the city there was, when the existing project of improvement was adopted, a low-water depth of only 1½ fathoms. The mean rise and fall of tide is about 6.6 feet. Operations for the improvement of this harbor have been carried on in accordance with a project of improvement prepared by General Gillmore, the officer then in charge, and printed as Appendix M 12, Annual Report of the Chief of Engineers for 1886. This project is an enlargement and a modification of a previous one submitted by the same officer and printed as Appendix J 7, Annual Report of the Chief of Engineers for 1880.

The following comprise the main features of the plan of improvement:

(1) A training wall projecting from the most easterly point of Buzzard Island and located approximately parallel to and 1,000 feet or less distant from the opposite shore of East River.

(2) A low dam across Turtle River extending obliquely upstream from the upper end of Buzzard Island to the opposite shore of Blythe Island.

(3) Short spur jetties in the lower part of East River.

(4) Dredging in the vicinity of Turtle River Dam and on the shoal in the lower part of East River.

The training walls and spurs were to be constructed of palmetto cribs loaded with stone, or of successive courses of log and brush mattresses loaded with riprap stone. The works were intended to establish and maintain a 15-foot low-water channel across the shoal in East River. The cost of the original project was estimated at $73,187.50, and as modified at $190,000.

In his report of November 26, 1894, concerning a revision of the project of improving harbor at Brunswick, Captain Carter stated that—

> It will be more economical and advantageous to maintain the desired depth of 15 feet at mean low water by keeping the training wall in good condition and by annual dredging than by constructing a dam across Turtle River and further channel contraction.

Captain Carter also estimated the cost of maintenance at $15,000 per annum, provided that sum be made available each year.

The entire amount expended on the improvement of Brunswick Harbor from its commencement, including an appropriation of $10,000 made in 1836 for dredging, to June 30, 1896, including all outstanding liabilities, was $210,000, of which $10,000 was for maintenance.

The amount expended on the existing project to June 30, 1896, including all outstanding liabilities, was $200,000, and had resulted in the construction of a training wall 4,509 feet long and in the dredging of 315,731.43 cubic yards of material.

At the end of the fiscal year of 1896 the training wall was in good condition and there was a practicable channel of about 15 feet at mean low water throughout the harbor.

The total amount expended during the fiscal year just closed, including all outstanding liabilities, is $12,322.16, and has resulted in excavating 14,571.3 cubic yards of material from the channel in front of the city and 45,111.9 cubic yards of material from Academy Creek, making a total of 59,683.2 cubic yards excavated during the fiscal year for maintenance.

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Before the improvement (in 1880) the annual tonnage of the port of Brunswick was about 100,000, consisting chiefly of lumber, naval stores, wood, rice, and sundry provisions, and valued at about $1,700,000. In 1896 the shipments of lumber, railroad ties, cotton, and naval stores were valued at more than $10,000,000.

July 1, 1896, balance unexpended		$15,000.00
June 30, 1897, amount expended during fiscal year		8,268.34
July 1, 1897, balance unexpended		6,731.66
July 1, 1897, outstanding liabilities	$4,053.82	
July 1, 1897, amount covered by uncompleted contracts	1,590.12	
		5,643.94
July 1, 1897, balance available		1,087.72

Amount that can be profitably expended in fiscal year ending June 30, 1899, for maintenance 15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix N 8.)

9. Cumberland Sound, Georgia.—The available depth of the entrance in its unimproved condition varied from 11 to 12.5 feet at mean low water. The mean rise and fall of tide is 5.9 feet. The original plan for improving the entrance to Cumberland Sound was submitted in 1879 and is given in Appendix I 8, Annual Report of the Chief of Engineers for that year. The revised plan of improvement was submitted in 1891 and is contained in Appendix N, Annual Report of the Chief of Engineers for that year. A second revision of the original plan of improvement, rendered necessary from the fact that funds were supplied irregularly and in entirely inadequate amounts for the proper prosecution of the work, was submitted by Captain Carter on June 12, 1895, and is contained in the report of the Chief of Engineers for 1896, page 1293. This plan of improvement was submitted to a Board of Engineers, whose report, dated December 18, 1895, is given in the Report of the Chief of Engineers for 1896, page 1289. It contemplates the construction of two jetties, composed of riprap stone with a mattress hearting wherever admissible, resting upon a foundation mattress of brush or of logs and brush, starting respectively from the shores on opposite sides of the entrance and extending seaward across the bar upon lines so directed that the ends, resting in 30 feet at mean low water, will be parallel to each other and about 3,900 feet apart. Those jetties are intended to establish a mean low-water channel across the bar not less than 19 feet in depth.

This project was authorized by the law of June 3, 1896, and in accordance with it work has been carried on during the fiscal year just ended. The cost of the improvement was originally estimated at $2,071,023, as revised in 1891 at $2,079,500, and as revised in 1895 at $2,350,000.

The entire amount expended on the improvement of the entrance to Cumberland Sound, from its commencement to June 30, 1896, including all outstanding liabilities, was $932,500, and had resulted in carrying the north jetty 18,308.8 feet and the south jetty 10,062.48 feet seaward from their initial points on shore. There had been used in this work 574,276 square yards of mattresses, 133,866.74 cubic yards of riprap stone, and 2,071.80 cubic yards of oyster shells.

At the end of the fiscal year of 1896 the unfinished jetties were in good condition. Owing to the lack of funds, it had been impracticable to carry on operations with vigor and thus to obtain control of the channel location. The latter crossed the south jetty and then extended

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eastward to deep water of the ocean. The least channel depth over the bar was reported to be about 15 feet.

The river and harbor act approved June 3, 1896, contained an appropriation of $5,000 for continuing the improvement, with the following provision:

Provided, That contracts may be entered into by the Secretary of War for such material and work as may be necessary to complete the present project, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate two million three hundred and forty-five thousand dollars, exclusive of amount herein and heretofore appropriated.

Under this provision a contract was entered into October 8, 1896, with the Atlantic Contracting Company, of New York, N. Y., for all jetty work required for the improvement. Work was commenced on December 7 and continued to the end of the fiscal year. During this time the north jetty was extended 1,577.8 feet to Station 19,862.8 and the south jetty was extended 3,792.2 feet to Station 13,854.7. There were put into the north jetty 92,345.34 square yards of brush mattresses, 4,794.30 cubic yards of third-class and 842.94 cubic yards of fourth-class riprap stone. There were put into the south jetty 253,942.38 square yards of brush mattresses, 4,643.66 cubic yards of third-class and 8,018.35 cubic yards of fourth-class riprap stone.

The channel still crosses the south jetty and the depth over the bar has decreased to 13 feet at mean low water. A new north channel seems to be making between the jetties; this can be hastened by dredging, and if once formed may be held in that location by a vigorous prosecution of the jetty work.

Before the improvement (in 1879) the annual in and out bound tonnage at Fernandina was about 300,000, and the value of imports and exports about $2,500,000, lumber, naval stores, and cotton being the principal articles. In 1896 these figures had risen to about 400,000 and about $9,500,000, respectively. In addition to the former articles of export, a considerable amount of phosphate rock was shipped coastwise and to foreign ports.

July 1, 1896, balance unexpended	$5,000.00
Amount appropriated by sundry civil act approved June 4, 1897	350,000.00
	355,000.00
June 30, 1897, amount expended during fiscal year	4,170.99
July 1, 1897, balance unexpended	[1] 350,829.01
July 1, 1897, outstanding liabilities	449,360.63
July 1, 1897, amount covered by uncompleted contracts	[2] 1,692,510.98

Amount (estimated) required for completion of existing project	1,995,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	450,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix N 9.)

10. Inside water route between Savannah, Ga., and Fernandina, Fla.—The location of this route is shown by a dotted line on Coast Survey Charts Nos. 156 and 157, and a detailed description of it and its original condition is given in Captain Carter's report of a survey dated November 25, 1891, which is printed as part of Appendix N 12, Annual Report of the Chief of Engineers for 1892, pages 1311–1326.

[1] The sum of $345,000 of this amount is to be paid to contractor for work done, reserving $5,829.01 for contingencies.

[2] This work is carried on under a continuing contract.

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The distance from Savannah to Fernandina by the inside route just described is about 160 miles.

Touching at Darien en route increases the distance by about 20 miles, and at Brunswick by about 12 miles.

In its original condition the channel depth was less than 5 feet at mean low water in some places.

The original project of improvement, adopted in 1892, provides for the establishment of a channel 7 feet deep at mean low water between Savannah, Ga., and Fernandina, Fla. This is to be accomplished by the improvement of Romerly Marsh, Mud River, Little Mud River, and Jekyl Creek by means of dredging and the construction of closure dams and training walls of brush mattresses loaded with riprap stone. The estimated cost of the improvement is $105,000, provided that the entire sum is made at once available. If funds are made available in smaller amounts, the cost of the improvement will be increased.

The work so far has been entirely confined to Jekyl Creek, where the channel depth is 6 feet now as against 4.08 feet on the bar at the mouth before improvement.

The total amount expended up to June 30, 1896, including all outstanding liabilities, was $35,000, and, together with the appropriations made for Jekyl Creek, resulted in the completion of the training wall at the mouth and the removing of 63,330.97 cubic yards of material from the channel in the creek and over the bar at the mouth.

So far as known, the training wall at the mouth of Jekyl Creek and the dredged channel at and near the same locality were in good condition at the end of the fiscal year of 1896.

No work was done during the fiscal year just ended; the training wall remains in good condition, but the channel has shoaled about 1 foot at a place inside and at another one outside.

The value of the commerce passing through this route was estimated in 1890 at between $200,000 and $400,000 per annum. For 1896 the commerce is estimated at 20,000 tons, valued at $2,000,000.

July 1, 1896, balance unexpended		$14,000.00
June 30, 1897, amount expended during fiscal year		1,489.49
July 1, 1897, balance unexpended		12,510.51
July 1, 1897, outstanding liabilities	$270.00	
July 1, 1897, amount covered by uncompleted contracts	11,000.00	
		11,270.00
July 1, 1897, balance available		1,240.51

Amount (estimated) required for completion of existing project	56,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	56,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix N 10.)

11. Removing sunken vessels or craft obstructing or endangering navigation.—The removal of the wreck of an unknown wooden vessel or raft of logs sunk in Darien Harbor, for which an allotment of $900 was made by the Secretary of War, will be undertaken early during the coming fiscal year.

(See Appendix N 11.)

SURVEY MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The survey of *Doboy Bar, Georgia*, with a view to securing a depth of 24 feet at mean high water, and to ascertain whether the present

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obstruction can be removed by means of dredging, required by the act of June 3, 1896, was made by the local engineer, Capt. O. M. Carter, Corps of Engineers, and report thereon submitted February 25, 1897, through the division engineer, Col. Peter C. Hains, Corps of Engineers. Captain Carter states that the material composing the bar is a mixture of fine sand and fragments of shells and when loosened and thrown into suspension is easily moved, and that such material can be handled readily by a hydraulic dredge.

To dredge a channel 300 feet wide and 24 feet deep at mean high water along the line proposed by the local officer will require the removal of about 450,000 cubic yards of material. Should it be practicable to secure the use of a Government hydraulic dredge for this work, which is doubtful, it is estimated that the cost of opening the channel will not exceed $45,000. If no such dredge be available, the cost will be about $70,000. The cost of maintenance is indeterminate.

Unless sufficient funds be provided at one time to complete the improvement, Captain Carter recommends that no work whatever be done there. In his opinion the improvement of Doboy Bar is worthy of being undertaken by the General Government only to the extent and under the conditions stated in his report, and these views are concurred in by the division engineer, Colonel Hains.

The report was transmitted to Congress and printed in House Doc. No. 13, Fifty-fifth Congress, first session. (See also Appendix N 12.)

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN FLORIDA.

This district was in the charge of Lieut. Col. W. H. H. Benyaurd, Corps of Engineers, having under his immediate orders Lieut. James J. Meyler, Corps of Engineers, to February 19, 1897, and Lieut. Robert P. Johnston, Corps of Engineers, since September 14, 1896.

1. St. Johns River, Florida.—The original plan contemplated the formation of a continuous channel with a mid-depth of not less than 15 feet at mean low water from Jacksonville to the ocean, a distance of about 27.5 miles. The two points where work was required to gain this depth were at the bar at the mouth and in a reach of the river near Dames Point, 12 miles above. The work was divided into two parts:

1. The formation of a channel across the bar at the mouth by the concentration and direction of the tidal currents by two jetties to start from opposite shores at the entrance, and to converge until on the bar their outer ends should be approximately parallel and 1,600 feet apart.

2. The improvement of the Dames Point reach by dredging and the construction of works of protection under a project approved June 11, 1891, and modified March 28, 1892.

The bar at the mouth is formed of sand. Previous to the commencement of operations, the mean low-water channel depth across it varied from 5 to 7 feet, with a tidal range of 5.22 feet. The channel across the bar shifted continuously north and south through a range of about 1 mile.

It was estimated that the cost of obtaining a channel over the bar 15 feet in depth at mean low water by the approved project would be $1,306,409, and for improving the river in accordance with the approved modified project, which contemplated a navigable channel having a depth at low water of 18 feet from inside the bar to Jacksonville, would be $324,000.

The amount expended up to June 30, 1896, was $1,416,523.68.

The increased cost of the work already accomplished is $110,591.

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This is attributable to the fact that for many years during the early part of its progress long and frequent intermissions were made necessary by reason of a want of adequate appropriations for carrying on a work of this magnitude. Under these circumstances favorable contracts could not be made, and the uncompleted work was subject to great deterioration during these suspensions.

No work on the north jetty has been done since December, 1891. Its foundation at that time was out to Station 10,934. The south jetty has been extended to Station 10,712.

The improvement of the river between the bar and Jacksonville was effected by the citizens of Duval County, Fla., at a cost of $303,206.25.

Under authority granted in the river and harbor act of August 18, 1894, a report, with plans and estimates, was submitted for continuing the work of improving the stretch of the St. Johns River under consideration, with a view of securing a channel depth of 24 feet. The plan submitted contemplated, in addition to dredging the river, the raising and extension of both jetties, the estimated cost of both improvements being $2,109,750.

In the fall of 1895 the subject of the improvement at the mouth of the river and of its maintenance was referred to a Board of Engineer Officers. This Board recommended that the jetties should be raised from their inner ends out at an estimated cost of $500,000, and stated that permanence of channel depth could be maintained by extensions of the jetties or by dredging at an annual cost of about $30,000, in addition to first cost of dredge, estimated at $70,000.

Under the provisions of the river and harbor act of June 3, 1896, the project for securing a channel depth of 24 feet at mean low water from Jacksonville to the ocean was adopted, and the amount of $200,000 was appropriated for continuing operations in accordance therewith.

It was decided to expend $150,000 of the available amount by contract in raising the south jetty to the main height of the water at the beginning of ebb flow from the present end of the concrete coping at Station 1,260 to about Station 8,000, and such other work as this amount will permit.

A contract was entered into January 2, 1897, for the work contemplated. Work began March 18, 1897. At the end of the fiscal year a total of 21,917.05 tons of first-class stone and 213.36 tons of second-class stone had been placed upon the south jetty, building it up to the height desired between Stations 1,700 and 4,700 and between Stations 7,200 and 8,200.

A comparison of a map of a survey of the entrance to the river made in June with that of last year shows a slight improvement of the available channel depth across the bar. The available mid-channel depth at mean low water is 14¾ feet as against 14 feet last year. The shoal forming the crest of the bar has advanced seaward between 200 and 300 feet. The extensive shoal along the inside of the north jetty has increased somewhat in size and has encroached upon the channel so that opposite Station 3,000 of the south jetty the channel is some 200 feet narrower than last year. Ample width and depth exists at this place, however.

With the exception of the two lower cuts dredged in the river between Jacksonville and the bar the dredged channel has been maintained. In St. Charles and Browns Creek cuts the depth has increased. In the case of Brown Creek cut a slight deposit is noticeable in the lower end, the probable result of the scour above. At the two lower cuts, Cedar Creek and Mile Point cuts, a very considerable shoaling has taken place, more at the latter than at the former. The amount of this shoaling

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has not as yet been definitely ascertained. The available channel depth is now no greater in the river than on the bar at the mouth. The necessity for the building up and extension of the Cedar Creek training wall and the construction of a training wall at Mile Point cut is now beyond question, although the cost of the latter, which will be considerable, has not been included in the estimate for the improvement contemplated.

The manner of expenditure of the sum of $50,000, reserved from the appropriation under which work is now in progress, has not as yet been definitely decided upon. The object in view in reserving this amount was to have money available for the purpose of dredging the bar at the mouth should this prove to be advisable.

The following table shows the condition of commerce in 1880, when the work of improvement began; in 1886, just prior to the time the effect of the improvement was perceptible on navigation, and in 1896—all derived from records of the custom-house:

Year.	Vessels entered.			Vessels cleared.		
	Number.	Aggregate tonnage.	Average tonnage.	Number.	Aggregate tonnage.	Average tonnage.
1880	383	165,731	433	418	172,975	414
1886	383	123,176	322	271	116,044	428
1895	343	328,008	927	350	340,153	972
1896	378	358,946	923	374	360,311	964

July 1, 1896, balance unexpended		$200,476.32
June 30, 1897, amount expended during fiscal year		*35,974.74
July 1, 1897, balance unexpended		164,501.58
July 1, 1897, outstanding liabilities	$19,323.15	
July 1, 1897, amount covered by uncompleted contracts	85,412.08	
		104,735.23
July 1, 1897, balance available		59,766.35
Amount (estimated) required for completion of existing project		1,909,750.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		500,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix O 1.)

2. *Volusia Bar, Florida.*—The bar is located at the south end, or head, of Lake George, St. Johns River, about 162 miles from the mouth.

An examination of the locality with a view to improvement was made in 1879, and a plan was presented which contemplated the construction of two jetties carried out beyond the bar with their outer ends from 200 to 250 feet apart, with a view of obtaining a depth of 6 feet at low water over the bar.

Before any improvement was commenced the channel over the bar was very crooked and had a least depth varying from 3½ to 4½ feet.

The plan above presented was modified more or less in succeeding years, still maintaining the jetties, and dredging if necessary to assist in gaining the depth.

In 1887 this project was modified so as to limit the depth to 5 feet, already attained, which was deemed sufficient for the steamers navigating the upper St. Johns River.

With the appropriations made since the inception of the project, two

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jetties have been built starting from opposite sides of the river bank at the south edge of the lake and converging until upon the bar they are 230 feet apart. The east jetty is 3,400 feet long and the west jetty 2,200 feet. They are built to the level of mean low water throughout nearly their entire lengths. Two rows of firmly set piles provided with waling pieces confine boats to a 100-foot channel across the crest of the bar. Two hundred and fifty-eight cubic yards of material was dredged and the fender piles were repaired in November, 1893.

With the money made available for this work by the two appropriations of $1,000 each made by acts of August 18, 1894, and June 3, 1896, respectively, dredging to the extent of 4,242 cubic yards was done by contract in September and October, 1896. This resulted in a channel through the shoal near the ends of the jetties having a least width of 80 feet.

An appropriation of $2,000 is required each year to keep the bar in a navigable condition.

The amount expended up to June 30, 1896, was $26,790.91.

No commercial statistics are available prior to 1888. The amount of freight carried decreased from 15,537 tons in 1889 to 7,681 in 1896.

The improvement has had no effect on commercial interests except to render navigation safer and more reliable.

July 1, 1896, balance unexpended	$2,209.09
June 30, 1897, amount expended during fiscal year	2,209.09
Amount that can be profitably expended in fiscal year ending June 30, 1899, for maintenance	2,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix O 2.)

3. Ocklawaha River, Florida.—The Ocklawaha River has its source in Lake Apopka, central Florida, flows slightly west of north for about 104 miles, measured along the axis of the channel, then almost due east for 21 miles farther, when it unites with the St. Johns River. The Ocklawaha River is the principal outlet of a number of large lakes, the aggregate area of which is about 175 square miles.

From Lake Griffin down for a distance of about 28 miles the river flows through a wide savanna submerged about 1 foot under water and covered with a dense growth of saw grass. On this reach the river averages from 30 to 40 feet in width and has a least channel depth of about 5 feet; the current is very sluggish.

The impediments to navigation on this portion of the river are the numerous bends, the narrow channel, floating islands, and eelgrass. From the savanna to the mouth, a distance of about 58 miles, the banks are covered with a dense growth of cypress and other timber. On this reach the river averages from 60 to 70 feet in width, and the least channel depth is 4 feet. The average velocity of the current is considerably greater than on the upper river, being about 1.3 feet per second. The principal obstructions to navigation here are snags and overhanging trees.

The project for the improvement of this river consists in removing snags, overhanging trees, floating islands, and other obstructions of like character, so as to give a fair navigable channel of 4 feet depth from the mouth to Leesburg, at the head of Lake Griffin, a distance of 94 miles. The estimated cost of this work is $26,000.

All appropriations made prior to the one in act of June 3, 1896, have been expended in removing snags and overhanging trees. The result

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has been to place the river in a fairly navigable condition for a distance of about 60 miles from its mouth.

The amount expended upon this improvement to June 30, 1896, was $13,954.17. This amount includes $4,000 appropriated for maintenance. The appropriation of $3,000 for maintenance, made in act of June 3, 1896, will be expended in removing such logs and overhanging trees as have become obstructions during the cessation of work.

The improvement of this river has had no effect on commercial interests except to render navigation more safe. If the project were completed, large amounts of agricultural products and general merchandise would be carried by water from Leesburg to Jacksonville.

July 1, 1896, balance unexpended	$3,045.83
June 30, 1897, amount expended during fiscal year	45.83
July 1, 1897, balance unexpended	3,000.00
Amount (estimated) required for completion of existing project	15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899, including maintenance	17,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix O 3.)

4. St. Augustine Harbor, Florida.—The approved project is to protect the shores on the north and south side of the entrance from erosion, by groins constructed of riprap on brush foundation and capped with concrete.

Work was begun in 1889. Seven groins in all have been built, three on the north beach and four on Anastasia Island, on the south side of the entrance. Their lengths vary from 220 to 549 feet.

The erosion of the shore line has, with slight exceptions, been stopped. The outer portion of the north beach has been built out to the extremities of the groins.

The appropriation made in act of August 18, 1894, has not been expended, as there has seemed to be no immediate necessity for further work to protect the beach. The amount available is reserved for emergencies that may arise as the result of storms or a sudden wearing away of the shore line.

The amount expended up to June 30, 1896, was $64,925.84.

This improvement, being confined to the protection of the outer shore lines of the entrance, has had no effect whatever on the character and amount of commerce.

July 1, 1896, balance unexpended	$6,074.16
June 30, 1897, amount expended during fiscal year	74.06
July 1, 1897, balance unexpended	6,000.10
Amount (estimated) required for completion of existing project	24,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix O 4.)

5. Indian River, Florida.—Operations under existing projects and separate appropriations are intended to be carried on at three localities on this river, viz:

The portion of the river proper between Goat Creek and Jupiter Inlet, Negro Cut at Indian River Inlet, and Jupiter Inlet.

As provided for by the river and harbor act of 1890, a survey was made of that portion of the river between Goat Creek and Jupiter Inlet and a project approved, which contemplated making a continuous channel 5 feet deep at low water and at least 75 feet wide in the straight

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reaches, with as much greater width in the turns as may be required. It was estimated that the work proposed would cost approximately $44,000.

The Florida Coast Line Canal and Transportation Company possessed a franchise granted by the State of Florida which included this portion of the river and had dredged a continuous navigable channel along it 50 feet wide and 5 feet deep. After considerable delay the canal company made the necessary relinquishment of the rights they possessed under their franchise, and work under the appropriation of July 13, 1892, was commenced by the United States hydraulic dredge *Suwanee* July 28, 1895. The channel previously dredged by the Florida Coast Line Canal and Transportation Company was widened at Long Canal, High Bank Canal, Curved Canal, and Conch Bar, by dredging a cut 50 feet wide and 6 feet deep along one side. The aggregate length of all the cuts made by the United States was 11,075 feet, and the total amount dredged was 56,665 cubic yards.

Negro Cut.—The river and harbor act of August 18, 1894, appropriated $5,000 for dredging at Negro Cut, Indian River Inlet. The urgent deficiency act of March 2, 1895, made a further appropriation of $15,000 for the same work.

The approved project for this portion of the improvement contemplates the formation of a channel 100 feet wide and 6 feet deep from the channel of Indian River through Negro Cut to the bar at Indian River Inlet and the construction of a suitable training wall for its protection, at an estimated cost of $32,775.

Dredging began with the United States snag and dredge boat *Suwanee* on January 9, 1896, and the channel called for by the project was completed September 26, 1896. The total amount of material removed was 93,583 cubic yards.

The available channel depth before improvement began was 1½ feet.

The river and harbor act of June 3, 1896, appropriated $7,500 for the work at Indian River Inlet. The amount previously available being sufficient to complete the dredging, it is desirable to expend this appropriation in the construction of a training wall for the protection of the dredged channel as contemplated in the project, but under a decision of the Comptroller of the Treasury such an application of funds is not permissible without further action of Congress.

Jupiter Inlet.—By act approved February 26, 1896, an appropriation of $500 was made to open Jupiter Inlet for the passage of boats and small vessels.

An examination of this inlet was made March 15. It was found that the inlet was entirely closed by a ridge of sand extending from the bluff line on the north side to the bluff line on the south side, the ridge varying in width from 350 to 800 feet at low water. The crest of this ridge was at an elevation of from 7 to 9 feet above low water.

On August 19, 1896, a project for the improvement was approved calling for a cut 40 feet wide on the bottom and 2 feet deep at low water. An agreement to do the work for the amount of money appropriated, $500, was entered into August 31, 1896. Work began September 5 and was completed September 19, 1896.

The amounts appropriated for the different improvements to end of the fiscal year, June 30, 1897, are:

Indian River, between Goat Creek and Jupiter Inlet	$15,000
Negro Cut, Indian River Inlet	27,500
Jupiter Inlet	500

The amount expended on Indian River between Goat Creek and Jupiter Inlet up to June 30, 1896, was $15,000 and on Negro Cut $11,906.54.

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The commerce has materially decreased since 1894, when the improvement was commenced. At that time there were seven steamers plying on the river and all doing a good business, but the destruction of the oranges and lemons by the freeze of 1894–95 so seriously damaged trade that the steamers were laid up. During the past year a new line of steamers has been established by the Florida Coast Line and Transportation Company, and this company confidently expects a good business during the coming season.

INDIAN RIVER BETWEEN GOAT CREEK AND JUPITER INLET.

Amount (estimated) required for completion of existing project	$29,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	29,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

NEGRO CUT, INDIAN RIVER INLET.

July 1, 1896, balance unexpended	15,593.46
June 30, 1897, amount expended during fiscal year	6,193.97
July 1, 1897, balance unexpended	9,399.49
July 1, 1897, outstanding liabilities	600.00
July 1, 1897, balance available	8,799.49

JUPITER INLET.

July 1, 1896, balance unexpended	500.00
June 30, 1897, amount expended during fiscal year	500.00

(See Appendix O 5.)

6. Northwest entrance, Key West Harbor, Florida.—In 1882 an appropriation of $25,000 was made for dredging a channel through the bar at the northerly entrance over a width of 300 feet and to a depth of 17 feet at mean low water. As was anticipated, the improvement effected was only temporary.

The project now in course of execution contemplates gaining a depth of 17 feet at low water by the construction of a jetty on the northeast side of the passage or entrance, to be supplemented, if considered necessary, by a jetty on the west side and by dredging the bar.

Previous to the inception of this project the surveys showed a channel depth over the bar of 10.5 feet at mean low water.

With the appropriations made prior to that of June 3, 1896, aggregating $220,000, a jetty has been constructed on the northeasterly side of the entrance 11,354 feet in length. Of this 3,950 feet measured from the outer end has been built to the height of mean low water. The remaining portion of the jetty is at an average depth of 4½ feet below mean low water.

With the appropriation of $80,000, made in the act of June 3, 1896, it was decided to begin the construction of the west jetty. In order to determine the best location of this jetty, an extended series of borings to rock was required. The survey was completed in February, 1897. Bids for doing the work by contract were opened June 4, 1897, and the contract was awarded to the lowest bidder.

No survey of the present channel across the bar has been made recently, but it is believed that there has been no appreciable change either in the location or depth during the past fiscal year.

The amount expended up to June 30, 1896, was $216,734.09.

The estimate presented by the board appointed to consider the project for this improvement was for the construction of the east jetty and

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amounted to $500,000, although the board foresaw the probable necessity for the construction of a west jetty. Authority has been given for the commencement of construction of the west jetty, but no increase in the estimate has as yet been authorized.

The character of the commerce affected by this improvement is somewhat varied and complicated. If the improvement were completed, the channel would be used by all steamships plying to the Gulf ports, especially when westward bound. The improvement already effected has given a safe channel over the northwest bar for light-draft steamers at all times.

The commerce of Key West itself has decreased since 1892, owing to the removal of several cigar factories. The amount of freight carried through the northwest channel has, on the other hand, increased 50 per cent. This freight consists of agricultural products, cattle, lumber, sponges, cigars, tobacco, ship stores, and general merchandise.

July 1, 1896, balance unexpended		$83,265.91
June 30, 1897, amount expended during fiscal year		8,088.17
July 1, 1897, balance unexpended		75,177.74
July 1, 1897, outstanding liabilities	$43.40	
July 1, 1897, amount covered by uncompleted contracts	70,000.00	
		70,043.40
July 1, 1897, balance available		5,134.34

Amount (estimated) required for completion of existing project 225,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899 225,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix O 6.)

7. Caloosahatchee River, Florida.—An examination of this river with a view to its improvement was made in 1879. In 1887 a survey was made from Lake Okeechobee to the mouth.

The project adopted in 1882 called for deepening the channel by dredging from the mouth to Fort Myers, so as to give a depth of 7 feet at mean low water for a width of 100 feet. In 1886 and 1888 this project was modified so as to include the improvement of the upper river as far as Fort Thompson by the removal of snags and overhanging trees, and by deepening the channel near Beautiful Island to a depth of 4 feet.

Before improvements commenced upon this river there was a practicable channel 5 feet deep at mean low water from the mouth to 4 miles above Myers. The portion of the river which has the characteristics of an estuary was principally obstructed by oyster beds. Above, as far as Fort Thompson, the ruling depth was 3½ feet, on the shoal at Beautiful Island. This portion was obstructed by snags and overhanging trees.

With the money appropriated from 1882 to 1890 the shoals below Myers were dredged to a depth of 7 feet and the channels across the bars marked with suitable piles. Above Myers the shoal at Beautiful Island was dredged to 4 feet and a dike or training wall provided to concentrate the water through the dredged cut. A large number of snags have been removed from this portion of the river.

The appropriations since 1890 have been made for maintenance and they have been expended in removing such snags and overhanging trees as had become obstructions during the cessation of work, and in repairing the channel marks on the lower portion of the river.

An appropriation of $1,000 annually or $2,000 biennially will be required to keep this river in a fair navigable condition.

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The amount expended up to June 30, 1896, was $29,892.25.

It is proposed to expend the appropriation of June 3, 1896, amounting to $1,000, in clearing the river of such snags and overhanging trees; and dredging the shoals where they are less than the required depth, and in reestablishing such channel marks as may be necessary, so soon as the services of the United States snag boat *Suwanee* become available.

July 1, 1896, balance unexpended	$1,707.75
July 1, 1897, balance unexpended	1,707.75
July 1, 1897, outstanding liabilities	14.04
July 1, 1897, balance available	1,693.71
Amount that can be profitably expended in fiscal year ending June 30, 1899, for maintenance	2,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix O 7.)

8. Charlotte Harbor and Pease Creek, Florida.—Work upon this improvement was commenced under an appropriation of $35,000 made by the river and harbor act of September 19, 1890, for "improving, dredging, and deepening the channel of Charlotte Harbor and Pease Creek to the pier at Punta Gorda."

The survey from Boca Grande Pass to Punta Gorda made under this appropriation disclosed a channel depth of 19 feet at mean low water on the bar, 9 feet at the shoals south of Cape Haze, and 10 feet upon the shoals near the wharf at Punta Gorda. The rise of tide is approximately 2 feet.

The approved project contemplates the improvement of the channel so as to give a depth of 12 feet at mean low water from the wharves at Punta Gorda to the Pass over a width of 200 feet. The estimated cost was $127,500, reduced in 1896 to $100,000.

Operations have been carried on by dredging with a view of obtaining the width and depth contemplated. The work done under the first appropriation of $35,000 resulted in forming a channel 300 feet wide for a distance of 300 feet in front of the wharves, 160 feet wide for a distance of 4,729 feet, 120 feet wide for a distance of 1,764 feet, where it connects with the 12-foot contour. Over nearly the whole of this length the depth was attained of over 13 feet.

Under the second appropriation, amounting to $20,000, a channel was formed through the lower shoal near Cape Haze 200 feet wide and 12 to 13 feet deep at mean low water, and through the shoal near Charlotte Harbor Light an available channel depth across that shoal of 11½ feet at mean low water was secured.

The river and harbor act of June 3, 1896, appropriated $20,000 for continuing the improvement. Bids were opened March 10, 1897, to do the work by contract. Only one bid was received, and that at the rate of 29 cents per cubic yard. The bid was accepted and a contract was entered into March 27, and approved April 16, 1897. Dredging began April 26 and continued until June 26, when work was temporarily suspended owing to an accident to the boiler of the dredge. At the end of this fiscal year a total of 15,173 cubic yards had been removed.

The amount expended up to June 30, 1896, was $53,956.84.

The commerce of Charlotte Harbor has steadily increased since 1891.

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Most of the increase is due to the development of phosphate mines on Pease Creek.

The records show that arrivals and departures from Punta Gorda have increased from 408 in 1891 to 624 in 1895. No accurate information as to the tonnage is available owing to incomplete returns.

The commerce consists of cattle, fertilizers, agricultural products, lumber, fish and oysters, phosphate, and general merchandise.

July 1, 1896, balance unexpended		$21,043.16
June 30, 1897, amount expended during fiscal year		3,107.21
July 1, 1897, balance unexpended		17,935.95
July 1, 1897, outstanding liabilities	$2,531.42	
July 1, 1897, amount covered by uncompleted contracts	13,029.76	
		15,561.18
July 1, 1897, balance available		2,374.77
Amount (estimated) required for completion of existing project		25,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix O 8.)

9. Sarasota Bay, Florida.—The approved project upon which work has heretofore been done contemplated the formation of a continuous channel 100 feet wide and 5 feet deep at mean low water from Tampa Bay to the town of Sarasota, Fla., a distance of 21¼ miles, the estimated cost for this stretch being $17,500.

Previous to any attempt at improvement there was a navigable channel with a minimum depth of 5 feet extending throughout the length of Big Sarasota Bay, excepting in two reaches, Palma Sola Pass and Long Bar, which have a total length of 5,400 feet. In these reaches the available depth was 4.3 and 3.5 feet, respectively. The tidal range in the bay is 1.5 feet.

The work so far accomplished has resulted in the formation of a channel 40 feet wide and from 4 to 5 feet deep across the shoal at Palma Sola Pass and a channel 4,500 feet long, 50 feet wide, and 5 feet deep at Long Bar. There is now practically the depth but not the width of channel required by the project from Tampa Bay to Sarasota.

The act of Congress of June 3, 1896, appropriated $2,500 for improving Sarasota Bay from Tampa Bay to Caseys Pass, while heretofore the improvement was only for Sarasota Bay "from Tampa Bay to Sarasota, Fla." The survey of 1889 was made, as directed, from Tampa Bay to Caseys Pass and an estimate was presented amounting to $37,500 for securing a channel 75 feet wide and 3 feet deep at mean low water through the obstructing shoals below Sarasota. Under the act of June 3 last the latter project is included in the improvement, so that the total estimate of cost is now $55,000.

The amount expended to end of fiscal year ending June 30, 1896, was $9,998.43.

The commercial statistics for this bay have been incomplete. The adjacent country is still undeveloped, and its development depends largely upon the navigability of the bay. All trade is carried on by water, and the improvement effected has given a safe passage at all times for small vessels.

The commerce consists of cattle, fertilizers, agricultural products, lumber, and general merchandise.

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Such returns as are at hand for the past few years are here given, viz:

	Tons.		Tons.
1893	1,101	1895	1,665
1894	1,823	1896	2,390

July 1, 1896, balance unexpended	$2,501.57
July 1, 1897, balance unexpended	2,501.57
July 1, 1897, outstanding liabilities	215.14
July 1, 1897, balance available	2,286.43
Amount (estimated) required for completion of existing project	42,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	42,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix O 9.)

10. Manatee River, Florida.—Manatee River rises in the southern part of Florida, and flows in a westerly direction, emptying into Tampa Bay at its southern shore.

An examination of the river with a view to its improvement was made in 1881.

The original project adopted in 1882 contemplated forming a channel 100 feet wide and 13 feet deep from Tampa Bay to Shaw and McNeils points. In 1887 the project was extended so as to cover the river as far up as Manatee, and give a depth of 9 feet at mean low water.

For 12 miles from its mouth this river has the characteristics of an estuary. Before improvement in the estuary the general depth of the river varied from 7 to 20 feet. At the mouth there was a long shoal with a depth of 7 feet. Between Palmetto and Braidentown there was another bar covered by from 3 to 5 feet of water.

During and prior to 1890 a channel 150 feet wide and 8 feet deep was dredged through the shoal between Manatee and Braidentown. This channel seems to have maintained itself very well.

In 1893 a channel was dredged through the shoal at Sneads Point 81 feet wide and 12 feet deep.

During the past year the channel across the shoal at Sneads Point was extended and a shoal caused by the flattening of the side slopes was removed, so that it is now 100 feet wide and 12 feet deep, as contemplated in the project. Ten channel marks were constructed to enable vessels to follow the dredged channels.

The river and harbor act of June 3, 1896, appropriated $4,000 for continuing the improvement "provided that $3,000, or so much thereof as may be necessary, be used in dredging, deepening, and otherwise improving the navigation of the channel known as the Cut-off, extending from said Manatee River on the north side thereof, and below the town of Palmetto, into Terraceia Bay."

A survey of the Cut-off was made in February, 1897, in order to determine the character and extent of the improvement required. Based upon the results of this survey, a project was submitted which contemplates the formation of a channel 100 feet wide and 6 feet deep at mean low water connecting the 6-foot contours in Manatee River and Terraceia Bay at an estimated cost of $20,000. The amount of money at present available will be expended in furtherance of this project.

The improvement is a desirable one. The vicinity of Manatee River and Terraceia Bay is said to have become the largest shipping point on the west coast of Florida. The completion of this improvement will allow Terraceia Bay to have at least two steamers daily, touching each way, whereas it now has them only semiweekly.

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The total amount expended to June 30, 1896, was $42,863.69.

To do the work required on the bar at the mouth of the river in an economical manner the full amount of the balance of the estimate for completing the project, $29,000, should be made available before it is commenced.

Likewise the balance required to complete the improvement of the Cut-off, $17,000, should also be made available.

The officer in charge invites attention to the urgent necessity for the construction of a combined dredge and snag boat for use on the rivers and harbors of Florida at a cost of $50,000.

The improvement of this river has resulted in a steady increase in commerce, which, for this section, is carried on entirely by water. The statistics show an increase in the value of exports and imports from $816,326 in 1892 to $2,826,444 in 1896; during the same period the arrivals and departures of regular steamers increased from 900 to 1,200.

The commerce which is dependent entirely upon water transportation consists of agricultural products, fertilizers, lumber, and general merchandise.

The increase in tonnage, due to improvement of this stream, for several years past is shown by the following statement:

	Tons.		Tons.
1893	6,872	1895	11,718
1894	11,552	1896	21,000

July 1, 1896, balance unexpended	$4,136.31
June 30, 1897, amount expended during fiscal year	303.50
July 1, 1897, balance unexpended	3,832.81
July 1, 1897, outstanding liabilities	389.37
July 1, 1897, balance available	3,443.44
Amount (estimated) required for completion of existing project	29,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	29,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix O 10.)

11. Withlacoochee River, Florida.—The project for the improvement of this river calls for the removal of snags, overhanging trees, and loose rocks, and the deepening of some of the worst shoals and a bar at the mouth, so as to form a channel having an available depth of 2 feet during about half the year from the mouth in the Gulf of Mexico to Pemberton Ferry, a distance of 77 miles.

The amount expended to June 30, 1896, was $23,914.88.

The entire river has been gone over from the mouth to Pemberton Ferry and the worst obstructions removed. The work was done partly by hired labor and partly by contract. The project is practically completed, although there are still obstructions to be removed before navigation can be considered safe.

Aside from a survey of the river from the head of navigation to the mouth made with an allotment from the appropriation for examinations and surveys in river and harbor act of June 3, 1896, the maps of which are in course of preparation, there were no operations during the past fiscal year.

July 1, 1896, balance unexpended	$785.12
July 1, 1897, balance unexpended	785.12

(See Appendix O 11.)

12. Suwanee River, Florida.—The project for the improvement of the Suwanee River was adopted in 1879. The reach of the river covered

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by the project extended from Ellaville to its mouth in the Gulf of Mexico, a distance of 130 miles. At that time the obstructions in this portion of the river consisted of shoals composed of soft, unstratified limestone mixed with flint, extending partly or entirely across the river, in some instances covered with shallow deposits of sand and in others bare, also snags and overhanging trees. The channels across these shoals were often narrow and very crooked. Their depth at mean low water would vary from 15 inches to 3 feet. At places, large isolated limestone bowlders in the channel were constant sources of danger to navigation.

An examination of the river with a view to its improvement was made in 1879. The estimated cost of the work to be done was $55,158.

The proposed improvement consists in deepening the bar at the passes by dredging, the removal of snags and overhanging trees along the river, and deepening and improving the channel at various places by the removal of rocks and snags and construction of wing dams, so as to straighten, widen, and deepen the channel. The depth to be obtained is 5 feet through the bars at the passes for a width of 150 feet and up the river as far as New Branford, a distance of 80 miles. From there to Ellaville, a distance of 50 miles, the depth is to be 4 feet and the width 60 feet.

The aggregate amount of the appropriations for this work is $50,000. Of this $10,000 was authorized to be expended in the purchase or construction of a snag boat, with dredging and other machinery.

With this amount a boat was built, and it was placed in commission in April, 1889, since which time it has been in almost constant service on the rivers and harbors in Florida. While it has served its purpose admirably, considering its low cost and the hard duty it has performed, it is now old and is expensive to keep in repair. A new, larger, and more seaworthy boat is urgently needed to take its place; a recommendation to this effect is made in report on Manatee River.

A navigable depth of 5 feet at low water has been obtained from New Branford to the Gulf, and a depth of 3 feet at low water from New Branford up as far as Hudson, 10 miles below Ellaville.

With the appropriation of $3,000, made in the act of June 3, 1896, it is proposed to continue the work of improving the river in accordance with the approved project, using the United States snag boat *Suwanee.*

The amount expended up to June 30, 1896, was $46,494.23.

There were no operations during the past fiscal year.

The improvemement of the river has resulted in a steady increase in commerce since 1890. In that year the total value of imports and exports amounted to $1,234,000, while in 1896 the value was $1,470,470. The tonnage in the same period increased from 27,416 to 34,474. Seventy-five per cent of the commerce of the neighborhood is carried on the river.

July 1, 1896, balance unexpended	$3,505.77
June 30, 1897, amount expended during fiscal year	8.50
July 1, 1897, balance unexpended	3,497.27
July 1, 1897, outstanding liabilities	276.99
July 1, 1897, balance available	3,220.28

Amount (estimated) required for completion of existing project	15,158.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	15,158.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix O 12.)

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13. Removing sunken vessels or craft obstructing or endangering navigation.—Under date of May 14, 1896, an allotment of $27,000 was made for the purpose of removing nine wrecks that had been reported as liable to endanger navigation in Man of War Harbor, Key West, Fla. After due advertisement bids were opened for the removal of these wrecks August 20, 1896, and the contract was awarded to the lowest bidder. The amount bid was $11,340, and the contract was entered into September 18, 1896. The contract price was subsequently reduced to $10,240, as the owner of one of the obstructions desired to remove it himself. Actual work began October 13, 1896, and by January 23, 1897, all of the obstructions specified had been removed. During the removal of these wrecks seven others were discovered in the vicinity, and it was decided to remove them and also the wreck of the *Governor Marvin*, lying nearer the entrance to Key West Harbor. After due advertisement bids for the removal of these additional wrecks were opened April 24, 1897, and contract was entered into May 11, 1897. Work under this contract began June 21, 1897. By the end of June portions of three of the wrecks had been removed. Twelve thousand nine hundred pounds of chains, anchors, and miscellaneous ironwork recovered from the wrecks removed under the first contract was disposed of at public auction on April 2, 1897. The proceeds of the sale, amounting to $15, were deposited with the assistant treasurer of the United States at New York to the credit of the Treasurer of the United States on account of the fund to which it pertains.

Under date of December 1, 1896, the sum of $750 was allotted for the purpose of removing a lighter in Hillsboro River at Tampa, Fla. After advertisement by circular letter, bids were opened December 26, 1896. Eight bids were received, and the lowest was accepted. Work began January 20, 1897, and was reported as completed five days later at a total cost of $271.97.

The total amount expended during the year upon removal of wrecks was $12,374.31.

(See Appendix O 13.)

EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The preliminary examinations and surveys of the following localities, required by the act of June 3, 1896, were made by the local engineer, Lieut. Col. W. H. H. Benyaurd, Corps of Engineers, and reports thereon submitted:

1. Preliminary examination of Jupiter Inlet, Florida.—Lieutenant-Colonel Benyaurd submitted report of examination January 19, 1897. It is his opinion, concurred in by this office, that Jupiter Inlet is not worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 245, Fifty-fourth Congress, second session. (See also Appendix O 14.)

2. Preliminary examination of Orange River, Florida, to its confluence with the Caloosahatchee River, and thence to the Gulf of Mexico.—Lieutenant-Colonel Benyaurd submitted report of examination January 4, 1897. He states that the Caloosahatchee River has been improved below Myers so as to give a depth of water of about 7 feet at mean low tide, and that this depth would accommodate the commerce from Orange River. It is his opinion, which is concurred in by this office, that Orange River is worthy of improvement by the General Government. It is estimated that a survey for the preparation of plan and estimate of cost

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of improvement of Orange River would cost $1,200. The report was transmitted to Congress and printed in House Doc. No. 248, Fifty-fourth Congress, second session. (See also Appendix O 15.)

3. Preliminary examination of inside passage from Punta Rasa to Charlotte Harbor, Florida.—Lieutenant-Colonel Benyaurd submitted report of examination January 4, 1897. It is the opinion of the local officer, concurred in by this office, that this inside passage is worthy of improvement by the General Government. It is estimated that a survey for the purpose of preparing plan and estimate of cost of improvement would cost $1,500. The report was transmitted to Congress and printed in House Doc. No. 246, Fifty-fourth Congress, second session. (See also Appendix O 16.)

4. Preliminary examination of Hillsboro Bay, Florida, from its confluence with Tampa Bay through Hillsboro Bay and River to the city of Tampa.—Lieutenant-Colonel Benyaurd submitted report of examination January 19, 1897. It is the opinion of the local officer, concurred in by this office, that this locality is worthy of improvement by the General Government. No survey is necessary for the preparation of plan and estimate of cost of improvement. The report was transmitted to Congress and printed in House Doc. No. 229, Fifty-fourth Congress, second session. (See also Appendix O 17.)

5. Preliminary examination of Clearwater Harbor, Florida.—Lieutenant-Colonel Benyaurd submitted report of examination January 19, 1897. It is his opinion, concurred in by this office, that this harbor is not worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 249, Fifty-fourth Congress, second session. (See also Appendix O 18.)

6. Preliminary examination of Crystal River, Florida.—Lieutenant-Colonel Benyaurd submitted report of examination January 4, 1897. It is the opinion of the local officer that Crystal River is worthy of improvement by the General Government, provided that the channel to be improved is found not to contain rock. He therefore recommends that a survey, estimated to cost $1,800, be made with a view to ascertaining with certainty the character of the river bottom and preparing estimate of cost of the improvement required. His views and recommendations are concurred in by this office. The report was transmitted to Congress and printed in House Doc. No. 221, Fifty-fourth Congress, second session. (See also Appendix O 19.)

7. Preliminary examination of harbor at Cedar Keys, Fla.—Lieutenant-Colonel Benyaurd submitted report of examination January 4, 1897. He is of the opinion, concurred in by this office, that the harbor at Cedar Keys is not worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 247, Fifty-fourth Congress, second session. (See also Appendix O 20.)

8. Survey at Palmbeach, Fla.—Lieutenant-Colonel Benyaurd submitted report of survey January 23, 1897. The plan of improvement presented contemplates the construction of a breakwater on the reef extending some 200 or 300 feet northward of the ocean pier and southward some 1,000 to 1,500 feet, a cut through the reef near and beyond the southerly end of the breakwater, and the dredging of a basin inside. The total estimated cost of this work as given by the local officer is $600,000. The report was transmitted to Congress and printed in House Doc. No. 292, Fifty-fourth Congress, second session. (See also Appendix O 21.)

9. Survey of Biscayne Bay, Florida.—Lieutenant-Colonel Benyaurd submitted report of survey January 31, 1897. The plan of improvement presented provides for a channel along the line of the present

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buoyed channel at Cape Florida entrance 12 feet deep into the anchorage ground inside the shoals and 10 feet deep thence to Miami, with widths of 500 feet on the outer shoal, 300 feet along the inside portion of the outer shoal and through the inner shoal to the anchorage, and 150 feet thence to Miami. The cost is estimated at $239,000. A channel of similar widths and a depth of 12 feet throughout would cost $845,000. The report was transmitted to Congress and printed in House Doc. No. 295, Fifty-fourth Congress, second session. (See also Appendix O 22.)

10. Survey of Tampa Bay, Florida, from Port Tampa to the mouth of the bay.—Lieutenant-Colonel Benyaurd submitted report of survey June 30, 1897. The project submitted provides for obtaining a channel, by means of dredging, 24 feet deep at mean low water, 500 feet wide on the bar at the entrance to Tampa Bay, and 300 feet wide in the bay itself. The proposed work will, it is estimated, cost $336,000. This estimate is based upon the assumption that a contract will be authorized for the completion of the work under the continuous-contract system. The report was transmitted to Congress and printed in House Doc. No. 88, Fifty-fifth Congress, first session. (See also Appendix O 23.)

IMPROVEMENT OF RIVERS AND HARBORS IN WESTERN GEORGIA AND FLORIDA AND IN EASTERN ALABAMA.

This district was in the charge of Maj. F. A. Mahan, Corps of Engineers, having under his immediate orders Lieut. J. P. Jervey, Corps of Engineers. Division Engineer, Col. Peter C. Hains, Corps of Engineers.

1. Carrabelle Bar and Harbor, Florida.—Carrabelle is situated on the Gulf Coast of Florida, about 20 miles east of Apalachicola, at the mouth of Carrabelle or Crooked River, which constitutes the inner harbor and has a channel along the water front varying in depth from 9 to 15 feet, with a width of 100 feet.

A bar 1 mile wide between the 10-foot contours, having a depth at low tide of from 3 to 4 feet, obstructs the entrance from the river into St. Georges Sound.

The river and harbor act of June 3, 1896, adopted a project for improvement and appropriated $10,000 to be used in making a 10-foot channel from the mouth of Carrabelle River to the channel in the bay.

No estimate of the cost of this improvement has been submitted, and no work has been done under the project.

A contract for dredging across the bar a channel 10 feet deep has been made. Work is to begin July 1, 1897.

The value of the commerce of this place was reported in 1895 to be about $600,000 a year. As all vessels trading with Carrabelle have to enter and clear in the customhouse at Apalachicola, Fla., it is impossible to separate the commercial statistics from those of Apalachicola, Fla.

July 1, 1896, balance unexpended	$10,000.00
June 30, 1897, amount expended during fiscal year	207.54
July 1, 1897, balance unexpended	9,792.46
July 1, 1897, amount covered by uncompleted contracts	9,210.00
July 1, 1897, balance available	582.46
Amount that can be profitably expended in fiscal year ending June 30, 1899 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	10,000.00

(See Appendix P 1.)

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2. Apalachicola Bay, Florida.—When the first survey of the bar at the mouth of the Apalachicola River was made, in 1878, the depth of water across it was 3.5 feet; the channel was narrow and tortuous and unavailable for commerce. The width of the bar between the 8-foot curves inside and outside varies; it averages 7,000 feet, in round numbers.

The project of the improvement, adopted in 1879, provides for a channel 11 feet deep and 100 feet wide, this width to be increased to 200 feet if the results of the first cut should be such as to warrant the enlargement.

This project was amended in 1891 to include cutting a straight channel through Bulkhead Shoal (the ridge which separates Apalachicola Bay from St. Georges Sound on the east) 9 feet deep and at least 100 feet wide.

The amount expended on Apalachicola Bay up to June 30, 1896, was $141,729.55.

The condition of the improvement on June 30, 1896, was as follows: The channel across Bulkhead Shoal was in good condition. The cut through the bar at the mouth of the river, reopened in January and February, 1896, was beginning to fill up again.

The funds expended during the year ending June 30, 1897, were applied to redredging the cut across the bar at the mouth of the river. The cut made is 5,500 feet long and 50 feet wide, with a depth at low water of 8 feet.

The original project for the channel through the bar at the mouth of the Apalachicola River has never been realized, and so long as dependence is placed on dredging alone satisfactory results can not be assured, and the maintenance of the channel in its present condition will require an annual expenditure of not less than $10,000.

The commerce of the port is mainly in timber and stores. It was valued in 1896 at $2,666,882, and in 1897 at $3,847,000, an increase of $1,180,118. These materials are taken in lighters from the shore to the anchorage ground, about 20 miles away. Each foot of depth gained on the bars more than pays the cost of the towing out and back. With less than 7 feet much trouble is found.

July 1, 1896, balance unexpended		$12,270.45
June 30, 1897, amount expended during fiscal year		1,462.98
July 1, 1897, balance unexpended		10,807.47
July 1, 1897, outstanding liabilities	$305.83	
July 1, 1897, amount covered by uncompleted contracts	9,726.04	
		10,031.87
July 1, 1897, balance available		775.60
Amount that can be profitably expended in fiscal year ending June 30, 1899		40,000.00
Amount required during fiscal year ending June 30, 1899, for maintenance		10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix P 2.)

3. Apalachicola River, the Cut-off, and Lower Chipola River, Florida.—The channel of the Apalachicola River was 6 feet deep throughout its entire length of 105 miles. It was greatly obstructed by logs and snags brought into it by its tributaries, the Chattahoochee and Flint rivers.

Piles had been driven across the channel at Moccasin Slough by the Confederate authorities during the civil war. Drift catching on these piles formed a dam. The water, prevented from following its old chan-

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nel, cut a new one, very narrow and crooked, to the River Styx. Navigation was difficult at the Elbows on account of the abrupt bends.

The original project was to obtain a channel 100 feet wide and 6 feet deep, at an estimated cost of $80,333.

This project was amended in 1890 by adding to it the securing of a channel 60 feet wide and 5 feet deep through the Cut-off and Lower Chipola River.

There had been expended on this stream to June 30, 1896, the sum of $54,223.49.

The funds expended during the year ending June 30, 1897, were applied to snagging and to the repairs of the snag boat.

The appropriation made for this stream by the river and harbor act of 1896 was not sufficient to do any work in straightening the river at Moccasin Slough, the Elbows, the Cut-off, and Lower Chipola River.

The river is comparatively free from snags, logs, and other such like obstructions, but at Moccasin Slough, the Elbows, and at the Cut-off and Lower Chipola River work is necessary for straightening and widening the channel.

The commerce of this river is so combined with that of the Chattahoochee and Flint rivers that a separation is impossible. The commerce of these streams amounts to about $2,000,000 a year.

July 1, 1896, balance unexpended	$5,276.51
June 30, 1897, amount expended during fiscal year	3,823.63
July 1, 1897, balance unexpended	1,452.88
July 1, 1897, outstanding liabilities	50.00
July 1, 1897, balance available	1,402.88
Amount that can be profitably expended in fiscal year ending June 30, 1899	6,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix P 3.)

4. Flint River, Georgia.—This river was navigable only from its mouth to Bainbridge, Ga. The channel was narrow, crooked, and much obstructed by logs, snags, and overhanging trees. There was no navigation above Bainbridge except under very favorable conditions.

The original project called for a channel 100 feet wide and 3 feet deep, at extreme low water, from the mouth of the river to Albany, Ga., at a cost of $184,862. The distance is 105 miles.

This project was amended in 1879 so as to include giving a channel for light-draft steamers from Albany to Montezuma, 77 miles, by the removal of logs, snags, and overhanging trees, at a cost of $15,100.

The amount expended on this river to June 30, 1896, is $197,061.65.

The river is navigable at all seasons from its mouth to Bainbridge, a length of 30 miles. From Bainbridge to Sisters Islands, 39 miles, navigation is impossible at low water on account of rocks. From Kennedy Shoals to Albany, 36¼ miles, the channel has been cut gradually, a little every year, through the rock; so that this stretch is navigable all the year.

The available length of the channel added during the past fiscal year is about 1 mile.

The commerce of this stream is one with that of the Apalachicola and Chattahoochee, being all carried on by the same boats.

The freight carried is of miscellaneous character. The largest half dozen items in weight were provisions, naval stores, cotton, grain, fertilizer, and miscellaneous freight. Its total value for all three streams

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is about $2,000,000 a year. To this must be added the value of large quantities of timber rafted, for which no figures can be had, as no records are kept.

The commerce was valued in 1877 at $2,410,956, and in 1897 at $1,967,000 in round numbers; decrease of $443,956. Two steamers plying the river were lost during the year, and as it was impossible to get any statistics from their owners, a considerable portion of this decrease can be attributed to this cause.

July 1, 1896, balance unexpended	$8,938.35
June 30, 1897, amount expended during fiscal year	5,019.45
July 1, 1897, balance unexpended	3,918.90
July 1, 1897, outstanding liabilities	5.94
July 1, 1897, balance available	3,912.96
Amount that can be profitably expended in fiscal year ending June 30, 1899	26,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix P 4.)

5. Chattahoochee River, Georgia and Alabama.—Below Columbus.—This river is not navigable above Columbus, Ga. It was originally much obstructed from Columbus to its junction with the Flint, 224 miles, by logs, snags, and overhanging trees, and by a number of rock and marl shoals. Navigation was difficult and dangerous by day and impossible by night.

The present project for improvement provides for a low-water channel 100 feet wide and 4 feet deep from Columbus, Ga., to Chattahoochee, Fla., 224 miles, to be obtained by removing logs and snags from the channel and overhanging trees from the banks, by cutting through rock shoals and scouring out sand bars by means of works of contraction and shore protection.

The estimated cost of this work from Chattahoochee to Eufaula, Ala., 139 miles, is given as $145,247. No estimate can be found for the part of the river between Eufaula and Columbus.

The amount expended on this river to June 30, 1896, was $280,552.74.

The channel below Eufaula is nearly clear of obstructions, and boats drawing 3½ feet have little trouble in navigating the river.

There are still some bars and isolated obstructions which require removal. These are at St. Francis Bend, Rock Island, King Rock, and at other points where less work is needed. Much is needed in the way of repairs to the works at Hospital Reach, Upatoie, and Shell Creek.

The channel cut through marl reefs at Uchee, Culpeper, and Kowikee shoals and through the rock reef at Hardridges and Widow Browns shoals is still clear.

The annual accumulation of logs and snags is scattered over the length of the river, and makes low-water navigation dangerous.

The funds expended during the year ending June 30, 1897, were applied to snagging and opening the channel and to rebuilding the snag boat *Chattahoochee.*

The commerce of the stream is as stated under the Flint River.

The work on the Apalachicola, Flint, and Chattahoochee rivers is costly by reason of there being no proper working plant for dredging or rock removal. The three rivers form one system, and one plant could operate on all. A dredge and scows would cost $15,000. This cost would be saved in three seasons' work.

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July 1, 1896, balance unexpended	$29,447.26
June 30, 1897, amount expended during fiscal year	16,911.35
July 1, 1897, balance unexpended	12,535.91
July 1, 1897, outstanding liabilities	880.80
July 1, 1897, balance available	11,655.11
Amount that can be profitably expended in fiscal year ending June 30, 1899	93,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

Between Westpoint and Franklin.—This section of the river is 38 miles long. In its original condition there was a series of pools varying in length from half a mile to 5 or 6 miles, separated by rock shoals and rapids, at some of which the fall is as great as 8 feet in a mile. The channel in the pools is nowhere less than 4 feet deep and is from 300 to 500 feet wide. It is much wider on the shoals and its depth is frequently not more than a few inches. It was not available at all for commerce before improvement was begun.

No survey, project, or estimate of the cost of improving this part of the river has ever been made.

The river and harbor act of 1892 provided that $5,000 of the sum appropriated for the Chattahoochee River should be spent on this section.

The project for the expenditure of this sum was "to remove the lesser rock shoals, sand and gravel bars by excavation and works of contraction; to remove overhanging trees from the banks, and snags, logs, and other obstructions from the channel, and to overcome the more serious obstructions by the construction of locks and dams, to give a minimum depth of 3 feet at low water in the channel between Westpoint and Franklin, a distance of 38 miles."

There had been spent on this work to June 30, 1896, $9,580.84.

A low-water channel 50 feet wide and 3 feet deep had been obtained through Roberts, Flat Rock, and Haynes Island shoals.

All has been done on this section of the river that can be done without the construction of locks and dams. To make it available for navigation will require these expensive structures.

July 1, 1896, balance unexpended	$5,419.16
June 30, 1897, amount expended during fiscal year	50.00
July 1, 1897, balance unexpended	5,369.16

(See Appendix P 5.)

6. Choctawhatchee River, Florida and Alabama.—Before the improvement of this stream was begun it was, notwithstanding its average width of 300 feet, almost totally obstructed by the accumulation of logs and snags. Navigation was only possible for flatboats and rafts. The channel was exceedingly dangerous, especially during the lower stages of water.

The project for improvement adopted in 1880 provided for a low-water channel from the mouth of the river to Geneva, Ala., 125 miles, and a navigable high-water channel from Geneva to Newton, Ala., 37 miles.

This project was amended in 1890 so as to provide for a low-water channel from Geneva to Newton.

The project has been further amended (river and harbor act of 1890) so as to require a draw, approved by the Secretary of War, to be placed in Hollis Bridge before any money may be spent above this bridge.

The improvement consists in removing logs and snags and trees from the channel and banks, and in protecting the banks where necessary, in cutting through rock and marl shoals and sand bars.

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The expenditures on this river to June 30, 1896, were $138,712.14.

On June 30, 1896, the river from its mouth to Caryville was sufficiently clear to meet the requirements of the present commerce; there was a fairly navigable channel, except at extreme low water, from Caryville to Geneva, and a partly improved channel from Geneva to Pate Landing, a distance of 25 miles. Steamboats could run quite regularly between Geneva and the railroad crossing at Caryville. Boats carrying large amounts of freight had little trouble in running the river either by day or night.

The snag boat only was in operation during the year 1897. It made two trips over the river between Caryville and Geneva, removing practically all snags and sunken logs. There was no increase in width or depth of the channel during the year.

The commerce of this stream is mainly cotton, stores, logs, and timber. It was valued in 1880 at $1,740,500, and in 1897 at $2,900,000, an increase of $1,159,500.

July 1, 1896, balance unexpended	$5,164.48
June 30, 1897, amount expended during fiscal year	3,526.09
July 1, 1897, balance unexpended	1,638.39
July 1, 1897, outstanding liabilities	89.00
July 1, 1897, balance available	1,549.39
Amount that can be profitably expended in fiscal year ending June 30, 1899 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	20,000.00

(See Appendix P 6.)

7. Harbor at Pensacola, Fla.—The channel leading into Pensacola Bay was much obstructed by wrecks in 1878. A survey made in 1879 showed that the depth of water across the inner bar had been reduced to 19.5 feet at mean low water, a depth insufficient for the commerce of the port. The western shore of the gorge of the bay was cutting away fast, and almost the whole of Fort McRee which stood there had been washed away.

The first project of the improvement considered only the removal of wrecks and the making of a survey to determine what more should be done. As a result of this survey, a Board of Engineers recommended, in 1881, dredging across the inner bar a channel 300 feet wide and 24 feet deep at mean low water for the temporary relief of navigation, and protecting the shore near Fort McRee from further washing.

This project was never carried out in its entirety. The greatest width ever obtained was but 225 feet—this in the autumn of 1893. The shore protection for the west bank was built in 1890. It consists of two jetties—one 360 and the other 220 feet long—made with a structure of riprap and a concrete coping. The shore line has been maintained.

Another Board recommended, in 1891, the procurement of a channel across Caucus Shoal by means of two jetties, one starting from the east, the other from the west, side of the entrance, assisted by a certain amount of dredging, the estimated cost being $1,830,000.

Before work was begun on this project further studies of the condition at the entrance caused a reconsideration. The matter was referred in August, 1895, to another Board of Engineers, which recommended dredging to be tried before beginning the building of the jetties. The success attending the dredging was such that the same Board recommended at a second session in March, 1896, the construction of a dredge especially for this harbor, and a channel 300 feet wide by 30 feet deep to be dredged.

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There had been expended at this harbor up to June 30, 1896, $395,087.57.

The exact depth of the channel across the inner bar on June 30, 1896, is not known. It was, however, between 20 and 21 feet, with a width of little more than 100 feet.

There was constant trouble for vessels going in and out. No attempt was ever made to cross the bar except at high water. Vessels loaded for sailing had to wait frequently two to three weeks for conditions favorable to their leaving port.

A channel had been dredged through the Caucus Shoal on the line of the ebb currents. The depth of water on the axis of the cut was increased from a least depth of 14.4 feet to a least depth of 23 feet.

The funds expended during the past year have been devoted to preparing the designs of a dredge and to redredging the cut through the Caucus Shoal which had filled up a little as a consequence of the storms of the fall, winter, and spring of 1896–97.

Vessels drawing as much as 23 feet are now passing through the new channel.

The commerce of the port consists mainly in timber, lumber, cotton, coal, pig iron, and miscellaneous stores of all kinds. It was valued in 1877 at $2,276,920, and in 1896 at $4,175,983, an increase of $1,899,063. In 1897 the outbound commerce to foreign ports is reported at $8,069,294 by the collector of the port. This result has followed the opening of the new channel through the Caucus Shoal.

July 1, 1896, balance unexpended	$254,912.43
June 30, 1897, amount expended during fiscal year	30,828.49
July 1, 1897, balance unexpended	224,083.94
July 1, 1897, outstanding liabilities	10,872.06
July 1, 1897, balance available	213,211.88
Amount that can be profitably expended in fiscal year ending June 30, 1899	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix P 7.)

8. Escambia and Conecuh rivers, Florida and Alabama.—The stream called the Escambia River in Florida is called the Conecuh in Alabama. It is one and the same stream.

This river is very important commercially, as it supplies two-thirds of all the timber, which is the principal shipping product of Pensacola. It was much obstructed originally by snags, sunken logs, and rock shoals and sand bars, and by a shallow bar at the mouth.

The project for improving the stream provides for the removal of snags, logs, and other sunken obstructions; for cutting through rock shoals, deepening sand bars, and dredging a channel through the bar at the mouth of the river in Escambia Bay.

There had been expended on these rivers up to June 30, 1896, $88,024.05.

The condition of the stream June 30, 1896, was such that rafts of timber or of logs could pass safely at a 2-foot stage from a point 106 miles up the river to its mouth, but the bar at the mouth was impassable for tugs.

Money spent in 1897 was for removal of many snags, logs, stumps, and trees, which came into the stream during times of high water and impeded the passage of rafts. No increase of width or depth was obtained.

The fact that tugs can not cross the bar at the mouth of the stream

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causes frequently great loss of timber, which has to float across the bar unaided and tie up outside, where it can be reached by the tugs.

The commerce of this stream is mainly timber and lumber. It was valued in 1884 at $566,500 and in 1895 at $2,000,000, an increase of $1,433,500.

July 1, 1896, balance unexpended	$4,475.95
June 30, 1897, amount expended during fiscal year	3,642.62
July 1, 1897, balance unexpended	833.33
July 1, 1897, outstanding liabilities	64.50
July 1, 1897, balance available	768.83
Amount that can be profitably expended in fiscal year ending June 30, 1899 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	18,000.00

(See Appendix P 8.)

9. Alabama River, Alabama.—The river was so full of sunken logs and snags that many steamboats were lost by running on them. Navigation was difficult and dangerous by reason of the many bars, shoals, and reefs, on which the depth of water was only 2.5 to 3.5 feet. Boats could run only by daylight during low stages of the river. Long detentions at the bars were frequent.

The original project of the improvement, adopted in 1876, called for a depth of 4 feet at low water from Wetumka, Ala., to the junction of the Alabama and the Tombigbee rivers, an estimated distance of 323 miles. This depth was to be obtained by removing logs and snags from the channel and overhanging trees from the banks, by cutting through rock and gravel bars by blasting and dredging, and by deepening sand bars by means of works of contraction and shore protection.

This project was amended in 1891 so as to provide for a depth of 6 feet.

There had been spent on this river, inclusive of maintenance and snagging, to June 30, 1896, the sum of $304,059.69.

The condition of the river at this date was such that navigation went on by night as well as by day between Montgomery and Mobile during ten months of the year. During the remaining two months the lack of depth of water on the bars between Montgomery and Selma prevented vessels from passing. The depth of water on several bars has been increased by 2 to 5.5 feet. The river was clear of logs and snags, except those which had fallen in during the high water of the preceding winter.

The funds expended in 1897 cleared the river completely of all snags and built a dike and shore protection at Hurricane Bluff and a dike at Lower Canton Bar. It has not been practicable to make an examination to determine how much good has been done at these points. It is known that an increase of depth has been obtained.

Many snags were brought in by the spring floods of 1897, which lasted much longer than usual. These had not been removed up to the end of the year, as the repairs of the snag boat had not been wholly finished.

The commerce of the stream in 1878 was valued at $5,055,000, in round numbers; in 1897 it is valued at $8,320,000, an increase of $3,265,000. It consists principally of cotton, naval stores, hides, staves, fertilizers, miscellaneous goods of all kinds, and large quantities of timber and lumber. As no record of the timber and lumber rafted is kept, the value thereof is not known.

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July 1, 1896, balance unexpended	$40,940.31
June 30, 1897, amount expended during fiscal year	32,576.68
July 1, 1897, balance unexpended	8,363.63
July 1, 1897, outstanding liabilities	1,133.73
July 1, 1897, balance available	7,229.90
Amount (estimated) required for completion of existing project	246,251.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	176,200.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix P 9.)

10. Coosa River, Georgia and Alabama.—The Coosa River extends from Rome, Ga., where it is formed by the junction of the Oostenaula and Etowah rivers, to a point 18 miles above Montgomery, Ala., where it unites with the Tallapoosa River to form the Alabama. Its length is about 315 miles.

The river was available for navigation from Rome to Greensport, Ala., a distance of 162 miles, before any improvement was made. From Greensport to Wetumka, Ala., 142 miles, the bed of the stream is so much broken up with reefs and shoals of rock as to make its navigation practically impossible. Many years ago cotton was carried down the river to Mobile on flatboats at high water, but no boat ever came back.

The river is divided by legislative action into two parts—that lying between Rome and the East Tennessee, Virginia and Georgia Railroad Bridge and that lying between the bridge and Wetumka. The first is 236 miles long; the second is 68 miles.

(*a*) *Between Rome, Ga., and the East Tennessee, Virginia and Georgia Railroad Bridge.*—The original project for this part of the stream contemplated a channel 3 feet deep and 80 feet wide. The width and depth were changed below Lock No. 3 to 4 feet and 100 feet, respectively. The channel was to be made by washing out sand bars and by cutting through rock reefs. Below Greensport lock and dams were to be built.

There had been spent on this part of the river to June 30, 1896, the sum of $906,394.32.

As the result of the expenditure of this sum the river has been made navigable from Rome, Ga., to Harts Ferry, Ala., about 1 mile below Lock No. 3, a total distance of 180 miles.

With the money spent during the year ending June 30, 1897, there has been accumulated a large amount of stone, gravel, and sand for building the floor of Lock 4, and the channel at McCoy Island and at Woods Reef has been deepened and widened.

The earliest record on file of the value of the freight carried is in 1888. It was then $1,242,244. The present value is $1,800,000. The freight is of a miscellaneous character.

July 1, 1896, balance unexpended	$57,305.68
June 30, 1897, amount expended during fiscal year	17,320.18
July 1, 1897, balance unexpended	39,985.50
July 1, 1897, outstanding liabilities	3,803.17
July 1, 1897, balance available	36,182.33
Amount (estimated) required for completion of existing project	800,133.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	256,822.14
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

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(*b*) *Between the East Tennessee, Virginia and Georgia Railroad Bridge and Wetumka.*—The condition of this part of the Coosa River before beginning improvements was such as to make navigation impossible. While there were many deep pools, the water on the rock reefs and shoals was insufficient to float a vessel of any sort, and the fall at many of the reefs is too great for a vessel to surmount.

The present project of improvement contemplates canalizing the river by the construction of 23 locks and dams. A great deal of channel work has also to be done.

The sum of $343,808.76 had been spent on this improvement to June 30, 1896.

The walls of Lock No. 31 are finished and ready to receive the gates and machinery for moving them and the valves and their machinery for filling and emptying the lock.

The cofferdam has been removed, and the space between the land wall and the river bank has been filled up.

A survey is now going on to obtain data for the preparation of plans for Locks 9, 10, and 11.

The condition of this part of the Coosa River is such that the entire section must be improved from end to end and connections be made with the navigation above and below before any commerce can be developed.

July 1, 1896, balance unexpended	$66,191.24
June 30, 1897, amount expended during fiscal year	20,360.45
July 1, 1897, balance unexpended	45,830.79
July 1, 1897, outstanding liabilities	1,240.41
July 1, 1897, balance available	44,590.38
Amount (estimated) required for completion of existing project	4,683,074.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	1,000,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix P 10.)

11. Operating and care of canals and other works of navigation on Coosa River, Georgia and Alabama.—The expenses of operating and care of Locks Nos. 1, 2, and 3, and the canal between Locks Nos. 2 and 3, during the fiscal year ending June 30, 1897, amounting to $6,137.92, exclusive of outstanding liabilities ($155) on June 30, 1897, have been paid from the permanent indefinite appropriation provided by section 4, act of July 5, 1884.

(See Appendix P 11.)

SURVEY MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The survey of *Apalachicola Bay, Florida, and the approaches to Apalachicola*, required by the act of June 3, 1896, was made by the local engineer, Maj. F. A. Mahan, Corps of Engineers, and report thereon submitted September 17, 1896, through the division engineer, Col. Peter C. Hains, Corps of Engineers. The plan of improvement proposed by the local officer contemplates the making of a channel 18 feet deep at low water, 150 feet wide at the bottom, from Apalachicola for a distance of about 10 miles through West Pass, which he estimates will require the dredging of 3,154,687 cubic yards, at a cost, in round numbers, of $350,000, founded on the supposition that the work will be let in one contract. Major Mahan states further that about $20,000 or

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$30,000 a year will be necessary to maintain the part of the channel nearest the town after the required depth has been obtained. In the opinion of the division engineer, these estimates of cost and maintenance are both too low.

It seems expedient to ask the attention of Congress to the fact that the execution of the project herein presented involves not only a large first cost, but a continuous heavy annual expenditure so long as the improvement is to be maintained; and experience on similar improvements indicates that the cost of securing and maintaining any certain depth of channel through such a bay as this is a most indeterminate quantity.

The report was transmitted to Congress and printed in House Doc. No. 129, Fifty-fourth Congress, second session. (See also Appendix P 12.)

IMPROVEMENT OF RIVERS AND HARBORS IN WESTERN ALABAMA AND EASTERN MISSISSIPPI AND OF BOGUE CHITTO, LOUISIANA.

This district was in the charge of Maj. Wm. T. Rossell, Corps of Engineers, having under his immediate orders Lieut. Harry Burgess, Corps of Engineers, to September 24, 1896, and Lieut. James B. Cavanaugh, Corps of Engineers, since September 27, 1896. Division Engineer, Col. Peter C. Hains, Corps of Engineers.

1. Mobile Harbor, Alabama.—This channel had originally a depth of 5½ feet through Choctaw Pass and 8 feet on Dog River Bar.

The original project was for a channel 10 feet deep at mean low water through Choctaw Pass and Dog River Bar.

From 1870 to 1878 the channel was deepened to 13 feet under a project submitted by Maj. C. B. Reese, Corps of Engineers, August 5, 1870, for a channel 300 feet wide and 13 feet deep at mean low water.

From 1881 to 1888 the channel was deepened to 17 feet under a project submitted by Lieut. Col. (then Capt.) A. N. Damrell, Corps of Engineers, for a channel 200 feet wide and 17 feet deep at mean low water, adopted in March, 1880. Before this project was completed a project was submitted by Lieutenant-Colonel (then Major) Damrell, and adopted in August, 1888, to dredge a channel of entrance from the Gulf of Mexico to the city of Mobile, of 280 feet width on top of cut, with a central depth of 23 feet at mean low water.

Act of September 19, 1890, extended the work up Mobile River to the mouth of Chickasabogue Creek, and increased the estimated cost to $2,043,800, with entire length of channel 33.09 miles and the entire length of continuous cut of 32.27 miles. This work was placed under continuous contract by act of July 13, 1892.

Joint resolution of Congress, approved March 16, 1896, revived the continuous contract and increased the amount by $160,000.

Work under joint resolution of Congress was suspended September 5, 1896.

Act of July 3, 1896, gave $60,000 for maintenance of the channel by dredging, and work is now being carried on under this appropriation.

The total amount expended on this improvement to June 30, 1896, is $3,372,183.47.

On June 30, 1896, there was a channel of navigable width and 23 feet deep at mean low water extending from the wharves at Mobile to deep water in the Gulf of Mexico.

All work done during the fiscal year ending June 30, 1897, has been dredging to maintain the channel and removing snags and deadheads

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by the U. S. S. *Maud*. Under the appropriation of $60,000 for maintenance a contract was made for the hire of dredging plant, and work under this contract began January 27, 1897, and is still in progress. Considerable fill has taken place and 20 miles of the channel now has less than 23 feet depth at mean low water. Vessels drawing 23 feet, however, continue to use the channel, as the material that has filled in is soft.

It is estimated that $60,000 will be required for annual maintenance.

Comparative statement of lumber, cotton, etc., shipped to foreign and coastwise ports, compiled from records of the Mobile Cotton Exchange.

Articles.	1897.	1896.	1895.	1894.
	Tons.	*Tons.*	*Tons.*	*Tons.*
Lumber	106,095	88,045	83,557	107,246
Timber	191,772	129,021	144,737	60,468
Shingles	299	185	825	2,259
Staves	167			
Cotton	76,874	52,090	29,941	9,835

July 1, 1896, balance unexpended		$221,447.21
Amount appropriated by act of June 4, 1897		25,000.00
		246,447.21
June 30, 1897, amount expended during fiscal year		190,808.53
July 1, 1897, balance unexpended		55,638.68
July 1, 1897, outstanding liabilities	$73.10	
July 1, 1897, amount covered by uncompleted contracts	28,601.37	
		28,674.47
July 1, 1897, balance available		26,964.21
Amount required for annual maintenance		60,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899, for maintenance		60,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix Q 1.)

2. Black Warrior River, Alabama.—The original condition of this river was such as to be practically closed to navigation on account of shoals at Tuscaloosa.

The name of "Black Warrior" is given to that portion of the Warrior River which lies above the city of Tuscaloosa, Ala.

The originally adopted project for the improvement of this river was approved in 1887, the object being to obtain a channel 6 feet deep by means of locks and dams from Tuscaloosa to Daniels Creek, a distance of 15 miles. The project calls for five locks and dams, at an estimated cost of $741,670.

During the fiscal year ending June 30, 1896, three locks and accessories were completed and opened to commerce in November, 1895.

The amount expended on the improvement up to the close of the fiscal year ending June 30, 1896, was $574,879.02.

The condition of the improvement on June 30, 1896, was such as to allow steamboats and barges to reach the coal mines and sawmills above Tuscaloosa at a low stage of water.

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The results obtained by the improvement of this river are increased depth and width of the channel for a distance of 9 miles above Tuscaloosa.

July 1, 1896, balance unexpended	$28,870.98
June 30, 1897, amount expended during fiscal year	8,868.74
July 1, 1897, balance unexpended	20,002.24
July 1, 1897, outstanding liabilities	84.88
July 1, 1897, balance available	19,917.36
Amount (estimated) required for completion of existing project	190,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	190,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix Q 2.)

3. Operation and care of locks and dams on Black Warrior River, Alabama.—These locks and dams are near Tuscaloosa, Ala., and are three in number, known as Locks Nos. 1, 2, and 3, Black Warrior River, Alabama. They were finished and opened to commerce July 1, 1896, and at that date their operation and care became a charge under the general law of July 5, 1884. They have been operated and cared for during the fiscal year ending June 30, 1897, at a cost of $5,564.43.

The commerce through the locks during the year amounts to 4,758 tons of coal and about 220 tons of lumber and general merchandise.

(See Appendix Q 3.)

4. Warrior and Tombigbee rivers, Alabama and Mississippi.—These rivers form the line of communication from the Warrior coal fields to tide water, and also for the products of the valley of the Tombigbee above Demopolis to Mobile.

(*a*) *Warrior River, Alabama.*—The original condition of the navigable channel of this river was obstructed to such an extent by snags, logs, overhanging trees, etc., as to make navigation at low water impossible, and dangerous during high water. The minimum width of the channel was 60 feet; the minimum depth 1 foot.

The originally adopted project for the improvement was to deepen the channel by jetty construction and to remove snags and cutting of overhanging trees so as to obtain for small boats a low-water channel 80 feet wide and 4 feet deep, at an estimated cost of $151,103.

The present project, adopted in 1890, is to obtain a channel 6 feet deep at ordinary low water, throughout, by removal of obstructions and building dams with gates, at an estimated cost of $557,000.

The amount expended on this project to the close of the fiscal year ending June 30, 1896, was $141,892.90.

The condition of the improvement on June 30, 1896, was such as to allow steamboats and barges of coal, and large rafts of logs and timber, to navigate this channel at a considerably less stage of water than before. The work was confined principally to the removal of obstructions. No steps have been taken toward permanent improvement.

The results obtained by the improvement of this river are greater width and depth of channel, giving greater security to steamboat and barge navigation from the coal fields. Large tracts of valuable bottom lands have been reclaimed and are being cultivated now, which before the improvement were subject to overflow.

The total amount expended on this improvement to June 30, 1897, is $181,516.80.

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Commercial statistics.

Articles.	1897.	1896.	1895.
	Tons.	*Tons.*	*Tons.*
Cotton	2,080	1,250	1,125
Grain	2,100	1,300	1,300
Iron	20	20	20
Lumber	50	50	50
General merchandise	1,300	1,200	1,150
Coal	2,000	500	.....
Total	7,550	4,320	•3,645

July 1, 1896, balance unexpended	$88,107.10
June 30, 1897, amount expended during fiscal year	39,623.90
July 1, 1897, balance unexpended	48,483.20
July 1, 1897, outstanding liabilities	1,583.95
July 1, 1897, balance available	46,899.25

Amount (estimated) required for completion of existing project..... 347,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899 500,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(*b*) *Tombigbee River, from its mouth to Demopolis, Ala.*—The original condition of the navigable channel of this portion of the river was such as to admit of steamboat navigation only during about six or eight months of the year, or during high water. The minimum width of the channel was about 100 feet, and the minimum depth 2 feet.

The project of 1879 was to afford a channel of navigable width and 4 feet deep at ordinary low water, from the mouth up to Demopolis, Ala., by removal of snags, logs, and overhanging trees, and the improvement of the worst bars.

The present project—adopted in 1890—is to secure a channel 6 feet deep at low water, by removal of logs, snags, trees, bank revetment, and the construction of locks and dams at an estimated cost of $508,808.

The amount expended on the improvement of this portion of the river up to the close of the fiscal year ending June 30, 1896, was $153,181.59, of which $45,145.58 was in preservation of the improvement.

The condition of the improvement on June 30, 1896, was such as to allow steamboats to ascend to Gays Landing, 130 miles above the mouth, during low water, and to Demopolis, Ala., at a 3-foot rise above low water.

The results obtained by the improvement, are greater security to steamboat navigation and rafting of logs and timber by increased width and depth of channel.

The work on the constructions of locks and dams at McGrews Shoal is progressing, but no improvement to navigation can be expected until the lock and dam are finished.

Commercial statistics.

Articles.	1897.	1896.	1895.
	Tons.	*Tons.*	*Tons.*
Cotton	7,800	8,350	7,000
Grain	5,525	4,420	5,010
Iron	95	92	100
Lumber	67,240	66,360	12,175
General merchandise	13,219	13,744	13,006
Coal	1,500	500	.....
Total	95,379	93,466	37,291

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July 1, 1896, balance unexpended		$176,818.41
June 30, 1897, amount expended during fiscal year		93,346.94
July 1, 1897, balance unexpended		83,471.47
July 1, 1897, outstanding liabilities	$1,900.84	
July 1, 1897, amount covered by uncompleted contracts	10,573.47	
		12,474.31
July 1, 1897, balance available		70,997.16
Amount (estimated) required for completion of existing project		178,808.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		200,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(*c*) *Tombigbee River, from Demopolis, Ala., to Columbus, Miss.*—The original condition of the navigable channel of this section of the river was such as to admit of navigation only during high water. The minimum width of the channel was only about 70 feet and the minimum depth was 2 feet, but it was obstructed by snags, logs, overhanging trees, etc.

Up to 1890 all appropriations were made general for the Tombigbee River; on September 19, 1890, an appropriation of $15,000 was made for the section of Tombigbee River from Demopolis to Columbus.

The project of 1890 provided for obtaining a channel 6 feet deep at low water, by the removal of snags and other obstructions and the building of dams with gates, at an estimated cost of $779,400.

The amount expended on the improvement of this section of the river by tree cutting, snagging, bank revetment, and contraction works, up to June 30, 1896, was $65,226.

The condition of the improvement on June 30, 1896, was such as to allow light-draft boats to navigate its entire length at a 3½-foot rise above ordinary low water. But it will require an annual expenditure of at least $10,000 to keep it free from snags, logs, etc., this being in addition to the amount necessary to carry out the original project.

The results obtained by the improvement of this section of the river are greater width and depth of channel, making steamboat navigation and rafting more secure. Large tracts of valuable bottom lands have been reclaimed and are now being cultivated, which were subject to overflow before the improvement.

Commercial statistics.

Articles.	1897.	1896.	1895.
	Tons.	*Tons.*	*Tons.*
Cotton	2,175	2,062	3,500
Grain	1,689	1,105	2,508
Iron	24	20	31
Lumber	16,820	16,590	7,000
General merchandise	4,149	3,436	7,103
Total	24,857	23,213	20,142

July 1, 1896, balance unexpended		$84,774.00
June 30, 1897, amount expended during fiscal year		17,086.30
July 1, 1897, balance unexpended		67,687.70
July 1, 1897, outstanding liabilities		252.71
July 1, 1897, balance available		67,434.99
Amount (estimated) required for completion of existing project		629,400.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		500,000.00
Amount required for maintenance in fiscal year ending June 30, 1899		10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

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(*d*) *Tombigbee River, from Fulton to Columbus, Miss.*—The original condition of the navigable channel of this section of the river was such that navigation was impossible except during high water. The minimum width of the channel was 50 feet and the minimum depth 1 foot.

The project of 1873 was to obtain a good high-water channel, at an estimated cost of $35,000, and was completed in 1882, at a cost of $27,293.65. Since 1882 there had been expended, in preservation of the improvement, to June 30, 1896, $6,663.44.

The amount expended on the preservation of the improvement during the fiscal year ending June 30, 1897, is $3,413.37.

The condition of the improvement on June 30, 1896, was such as to allow larger rafts of logs and timber to be brought down without trouble.

The results obtained by the improvement of this section of the river are greater width and depth of channel and the reclaiming of large tracts of valuable bottom lands, which were heretofore subject to overflow.

It is estimated that $5,000 will be required for maintenance during fiscal year ending June 30, 1899.

Commercial statistics.

Articles.	1897.	1896.
	Tons.	*Tons.*
Pine, cypress, and oak logs	32,192	20,000

July 1, 1896, balance unexpended	$11,336.56
June 30, 1897, amount expended during fiscal year	3,413.37
July 1, 1897, balance unexpended	7,923.19
July 1, 1897, outstanding liabilities	113.92
July 1, 1897, balance available	7,809.27
Amount that can be profitably expended in fiscal year ending June 30, 1899, for maintenance. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	5,000.00

(*e*) *Tombigbee River, from Walkers Bridge to Fulton, Miss.*—The original condition of the navigable channel of this section of the river was such that navigation for small rafts only was possible during high water, and then it was troublesome.

The project of 1888 was to obtain a good channel for navigation during high water by the removal of snags, logs, and overhanging trees, at an estimated cost of $11,000.

The amount expended on the improvement up to June 30, 1896, was $10,982.07, of which $3,390.96 was in preservation of the improvement.

The condition of the improvement on June 30, 1896, was such as to allow larger rafts of logs and timber to be brought downstream at a much lower stage of water.

The results obtained by the improvement are greater security to the transportation of rafts of logs and timber, and the reclamation of valuable bottom lands, which were heretofore subject to overflow.

It is estimated that $1,000 will be required for maintenance during the fiscal year ending June 30, 1899.

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July 1, 1896, balance unexpended	$2,017.93
June 30, 1897, amount expended during fiscal year	1,677.14
July 1, 1897, balance unexpended	340.79
Amount that can be profitably expended in fiscal year ending June 30, 1899, for maintenance. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	1,000.00

(See Appendix Q 4.)

5. Noxubee River, Mississippi.—The original condition of the channel of this river was such that navigation at all seasons and at all stages of water was impossible, except by small flats during four or five months of the year. The minimum width of the river was 60 feet, and the minimum depth of the channel 1½ feet.

The project of 1880 was to afford a channel for small steamers from the mouth to Macon, Miss., of navigable width and depth when the water is above ordinary low stage, at an estimated cost of $65,245.25.

The amount expended on the improvement of this river up to June 30, 1896, was $58,096.81, of which $8,384.27 was in preservation of the improvement. The project was completed.

No work has been done on this river during the last two years.

The condition of the improvement on June 30, 1896, was such as to allow navigation only during high water up to Macon, Miss.

The results obtained by the improvement of this river are greater width of channel, but no greater depth, making steamboat navigation, if any is carried on, more secure during high water.

There is no commerce whatever on this river now and has not been for years past.

July 1, 1896, balance unexpended	$3,903.19
July 1, 1897, balance unexpended	3,903.19

(See Appendix Q 5.)

6. Pascagoula River, Mississippi.—For the original condition, project, history, etc., of this river, both dredging and river improvement, see Annual Report of the Chief of Engineers for 1896, Part III, pages 1448, 1449, and 1450.

The original condition of the channel of the river above Moss Point was such as to allow vessels of 6½ feet draft to navigate for a distance of 10 miles up above Moss Point; from there up to the junction of the Leaf and Chickasahay rivers the river was not navigable except during high water. The minimum width of the channel was 60 feet and the minimum depth 1 foot, but it was filled with logs and snags.

The project of 1874 was for the removal of snags and overhanging trees throughout its entire length. Of the aggregate amount of the several appropriations made up to July 5, 1884, $15,000 was applied to the removal of snags, logs, and overhanging trees.

The present project for the improvement of the river above Moss Point—that of 1886—is to maintain the river in its improved condition, at an estimated cost of $2,500 annually.

The amount expended during the fiscal year ending June 30, 1896, on maintenance, was $3,126.87.

The condition of the improvement on June 30, 1896, was such as to allow vessels of 6½ feet draft to navigate a distance of 52 miles above the mouth all the year; from there up to the junction of the Leaf and

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Chickasahay rivers very little work has been done of late years, and it can be navigated only on a 5 or 6 foot rise above ordinary low water.

The results obtained in the maintenance of the improvement of the river during the fiscal year ending June 30, 1897, are greater width and depth of the channel, securing safer steamboat navigation, and rafting of logs and timber up to Cedar Creek, 55 miles.

By act of Congress of August 17, 1894, the sum of $13,000 was appropriated for "improving Pascagoula River, Mississippi: Continuing improvement, and so much of said sum as may be necessary may be used for removal of the bar in Horn Island Pass."

By act of June 3, 1896, the sum of $6,000 was appropriated for "improving Pascagoula River, Mississippi: Continuing improvement, and so much of said sum as may be necessary may be used for removal of the bar in Horn Island Pass."

The original condition of the navigable channel of Horn Island Pass was bad, owing to its obstruction, by a shoal known as the outer bar, where, during an examination made in October, 1896, a least depth of 18.4 feet was found, causing considerable trouble and delay for vessels passing in or out.

The originally adopted project for this pass was to dredge a channel 200 feet wide, 1,300 feet long, and 21 feet deep at mean low water through this outer bar, at a cost not to exceed $8,000.

Work on dredging was commenced March 8, 1897, and completed April 17, 1897.

The condition of the improvement on June 30, 1897, is such as to allow vessels to cross the bar at all times.

The result obtained by the improvement of this pass is a channel 200 feet wide, 1,300 feet long, and 20.5 feet deep at mean low water over the outer bar.

The total amount expended on the improvement of this river to June 30, 1897, is $199,646.77.

Comparative statement tabulated from information furnished by the United States custom-house.

Vessels cleared.	1897.		1896.	
	Number.	Tons.	Number.	Tons.
Foreign	150	62,614	175	98,712
Domestic	37	17,038	41	16,610
Via Ship Island	.....	85,764	.....	42,796
Total	187	165,416	216	158,118

Coastwise shipments not included in the United States custom-house statement.

Articles.	1897.		1896.	
	Tons.	Value.	Tons.	Value.
Lumber and timber	36,649	$218,795	14,654	$134,194
Rosin	3,600	54,000	3,000	45,000
Turpentine	800	58,000	600	45,000
Charcoal	7,800	39,000	4,438	35,500
General merchandise	127	1,020	197	3,880
Total	48,976	370,815	22,889	263,574

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July 1, 1896, balance unexpended	[1]$13,777.79
June 30, 1897, amount expended during fiscal year	12,924.56
July 1, 1897, balance unexpended	853.23
July 1, 1897, outstanding liabilities	68.18
July 1, 1897, balance available	785.05
Amount (estimated) required for completion of existing project	30,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	10,000.00
Amount required for maintenance above Moss Point in fiscal year ending June 30, 1899	2,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix Q 6.)

7. *Chickasahay River, Mississippi.*—The original condition of the navigable channel of this river was such that only small rafts could be carried down during high water, and then it was troublesome and dangerous. The minimum width of the channel was 50 feet, and the minimum depth 6 inches, but was filled with logs and snags.

The original project for the improvement of this river—that of 1890—was to obtain a good high-water channel from the mouth up to the railroad bridge at Shubuta, Miss., by the removal of snags, logs, overhanging trees, etc., at an estimated cost of $30,000.

In the river and harbor act, passed June 3, 1896, the original project was modified so as to carry the improvement only as far as the railroad bridge near Bucatunna, Miss.

The amount expended on the improvement of this river to June 30, 1896, was $13,516.92, of which $1,117.19 was in preservation of the improvement.

The condition of the improvement of this river on June 30, 1896, was such as to allow light-draft steamers to navigate the river from the mouth to the Winchester Rocks, 85 miles, on a 4-foot rise above low water; and to allow larger rafts of logs and timber to be brought down from Waynesboro, Miss.

The amount expended on the preservation of the improvement during the fiscal year ending June 30, 1897, is $3,454.04.

The results obtained by the improvement of this river are greater width and depth of channel, making steamboat navigation more secure up to the railroad bridge near Bucatunna, and rafting from Waynesboro to the mouth.

Commercial Statistics.

Articles.	1897.	1896.
	Tons.	*Tons.*
Logs and timber	15,650	22,105
Rosin	300	2,000
Turpentine	80	400
General merchandise		268
Total	16,030	24,773

NOTE.—There was no steamboat on the river during the year.

[1]Erroneously reported as $13,827.79, June 30, 1896.

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July 1, 1896, balance unexpended	[1] $3,483.08
June 30, 1897, amount expended during fiscal year	3,454.04
July 1, 1897, balance unexpended	29.04
Amount (estimated) required for completion of existing project	13,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	2,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix Q 7.)

8. Leaf River, Mississippi.—The original condition of the channel of this river was such that navigation was impossible on account of snags, stumps, logs, and overhanging trees. The minimum width of the river channel was 100 feet, and the minimum depth 2½ feet.

The project of 1890 was to obtain a high-water channel from the mouth of Bowie Creek to the mouth of the river, an estimated distance of 75 miles, by the removal of snags, stumps, logs, and overhanging trees, at an estimated cost of $25,000.

The amount expended on the improvement of this river up to June 30, 1896, is $9,676.40, of which $3,084.28 was in preservation of the improvement.

The condition of the improvement on June 30, 1896, was such as to allow light-draft boats and large rafts of logs and timber to navigate the river for a distance of 60 miles from the mouth up.

The amount expended during the fiscal year ending June 30, 1897, was $4,426.92, and resulted in giving a greater depth and width of channel from Bowie Creek down to Carters Bluff, 56 miles, making steamboat navigation and rafting more secure.

Commercial statistics.

Articles.	1897.	1896.
	Tons.	*Tons.*
Saw logs and timber	83,640	62,625
Rosin	440	.....
Turpentine	80	.....
Total	84,160	62,625

July 1, 1896, balance unexpended	$5,323.60
June 30, 1897, amount expended during fiscal year	4,426.92
July 1, 1897, balance unexpended	896.68
July 1, 1897, outstanding liabilities	30.00
July 1, 1897, balance available	866.68
Amount (estimated) required for completion of existing project	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix Q 8.)

9. Pearl River, below Jackson, Miss.—The original condition of the navigable channel of this river was such as to allow navigation only during high water, and then it was difficult and dangerous. The minimum width of the stream was 190 feet and that of the channel was 100 feet except through Holmes Bayou, 7 miles, where it was 65 feet. The minimum depth of the channel was 1½ feet.

[1] Erroneously reported as $3,533.08, June 30, 1896.

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The project of 1880 was to obtain a 5-foot channel at low water, but this depth was found impracticable and the project was modified in 1885 so as to provide for a 2-foot channel at low water, at an estimated cost of $145,940.

By the river and harbor act of June 3, 1896, the original project for improving Pearl River from Jackson to the mouth was modified so as to confine operations between the head of Holmes Bayou and Monticello, Miss.

The amount expended on the improvement of this river to June 30, 1896, was $138,179.65, of which $35,192.32 was in preservation of the improvement.

The condition of the improvement on June 30, 1896, was such as to allow light-draft boats to navigate from the mouth to Monticello, Miss., a distance of 160¾ miles, all the year.

The amount expended on the preservation of this improvement to June 30, 1897, is $40,909.19.

The results obtained by the improvement of this section of the river are greater width and depth of channel, giving greater security to steamboat navigation, and allowing larger rafts of logs and timber to be brought down the river.

Commercial statistics.

Articles.	1897.	Articles.	1897.
	Tons.		*Tons.*
Cotton	540	Cord wood	3,700
Rosin	600	Charcoal	10
Turpentine	90		
Staves	7	Total	4,947

July 1, 1896, balance unexpended	$19,945.35
June 30, 1897, amount expended during fiscal year	5,716.87
July 1, 1897, balance unexpended	14,228.48
July 1, 1897, outstanding liabilities	460.63
July 1, 1897, balance available	13,767.85
Amount (estimated) required for completion of existing project	40,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix Q 9.)

10. Pearl River between Carthage and Jackson, Miss.—The original condition of this part of the river was such as to make navigation almost impossible, except at high water. The minimum width of the river was 100 feet and of the channel 40 feet. The minimum depth was about 1 foot. The project of 1879 was to afford a clear channel of navigable width and 5 feet deep at low water from Carthage to Jackson, 105 miles.

In 1888 the original project was modified to provide for a depth of 2 feet, at an estimated cost of $50,000.

The amount expended on the improvement up to June 30, 1896, was $33,650, of which $8,634.66 was in preservation of the improvement.

The condition of the improved channel on June 30, 1896, was such as to allow light-draft boats to navigate safely on a 3-foot rise above ordinary low water throughout the entire distance.

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The results obtained by the improvement are greater depth and width of channel and more security to steamboat navigation.

It is estimated that $2,500 will be required for maintenance during fiscal year ending June 30, 1899.

Commercial statistics.

Articles.	1897.	1896.
	Tons.	*Tons.*
Cotton	50	300
Staves	200	270
Total	250	570

July 1, 1896, balance unexpended	$2,400.00
June 30, 1897, amount expended during fiscal year	300.40
July 1, 1897, balance unexpended	2,099.60
Amount that can be profitably expended in fiscal year ending June 30, 1899, for maintenance	2,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix Q 10.)

11. Pearl River between Edinburg and Carthage, Miss.—The original condition of this portion of the river was such that navigation at low water was impossible and at high water was difficult and dangerous. The minimum width of the channel was 30 feet and the minimum depth at low water 3 inches.

The project for its improvement, adopted in 1884, was to afford a high-water channel from Edinburg to Carthage, a distance of 24¾ miles, for six or eight months of the year, at an estimated cost of $13,464.

The amount expended to June 30, 1896, was $15,750, of which $5,167.51 was in preservation of the improvement.

During the fiscal year ending June 30, 1897, there was expended $207 in preservation of the improvement.

The project has been entirely completed, and the condition of the river on June 30, 1897, was such as to allow navigation by light-draft boats on a 4-foot rise.

It will be necessary to periodically remove obstructions if the improvement is to be retained.

The result obtained by the improvement of this section of the river is greater depth and width of the channel, giving greater security to steamboat and barge navigation. It is estimated that $1,000 will be required for maintenance during fiscal year ending June 30, 1899.

There is no commerce on the river.

July 1, 1896, balance unexpended	$500.00
June 30, 1897, amount expended during fiscal year	207.00
July 1, 1897, balance unexpended	293.00
Amount that can be profitably expended in fiscal year ending June 30, 1899, for maintenance	1,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix Q 11.)

12. Bogue Chitto, Louisiana.—The original condition of this river was such as to make navigation, except during very high water, impossible,

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owing to shoals and sand bars at the mouth and obstructions in the river above. The minimum width of the channel was 80 feet and the minimum depth 3 feet.

The project of 1890 was to obtain a clear 3-foot channel during the greater part of the year by opening the mouth and the removal of logs, snags, trees, fish traps, etc, up to Alford's bridge, a distance of 190 miles, at an estimated cost of $55,000.

The amount expended on the improvement of this river up to June 30, 1896, was $14,983.21, of which $564.60 was in preservation of the improvement.

The condition of the improvement is such as to allow light-draft boats and large rafts to pass through the mouth and up the river to Purvis Lake, 36 miles, with safety on a slight rise above low water.

No work has been done on this river for the last two years.

The results obtained by the improvement of this river are a greater width and depth of channel, giving more security to steamboat navigation and to rafting.

Commercial statistics.

Articles.	1897.	1896.
	Tons.	*Tons.*
Saw logs and timber (pine)	6,720	6,750
Saw logs (cypress)	60	.....
Total	6,780	6,750

July 1, 1896, balance unexpended	$5,016.79
June 30, 1897, amount expended during fiscal year	1,240.21
July 1, 1897, balance unexpended	3,776.58
July 1, 1897, outstanding liabilities	76.04
July 1, 1897, balance available	3,700.54
Amount (estimated) required for completion of existing project	35,000.00
Amount that can be profitably expended in fiscal year ending June 30,1899	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix Q 12.)

13. Survey of canal from Birmingham, Ala., to the Warrior River, Alabama.—This survey was provided for by the sundry civil act approved June 4, 1897.

A project for the survey has been submitted, and it is expected that active work will begin early in the next fiscal year.

(See Appendix Q 13.)

EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The preliminary examinations and surveys of the following localities, required by the act of June 3, 1896, were made by the local engineer, Maj. William T. Rossell, Corps of Engineers, and reports thereon submitted through the division engineer, Col. Peter C. Hains, Corps of Engineers:

1. Preliminary examination for canal to connect the Black Warrior River and Five Mile Creek, Alabama, via Valley Creek.—Major Rossell submitted report of examination November 28, 1896. He states that it is impossible to determine even the feasibility of this improvement

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except by a thorough and detailed survey, and that under these circumstances he is unable to report the improvement as either worthy or unworthy; but in view of the magnitude of the interests involved he recommends that a careful survey be made, after which a report can be submitted and the worthiness of the improvement determined. The Chief of Engineers concurs in the views of the local officer and recommends that provision be made for a careful survey of the locality, estimated to cost $15,000. The report was transmitted to Congress and printed in House Doc. No. 77, Fifty-fourth Congress, second session. (See also Appendix Q 14.)

2. *Preliminary examinations of Ship Island Pass, Mississippi, for channel between Gulf of Mexico and Ship Island Harbor, and for dredging channel to connect Ship Island Harbor with Gulfport.*—Major Rossell submitted report of examinations November 19, 1896. It is his opinion, concurred in by the division engineer and by the Chief of Engineers, that these localities are not worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 84, Fifty-fourth Congress, second session. (See also Appendix Q 15.)

3. *Survey of Horn Island Pass, Mississippi, and the passage leading from said pass to the anchorage inside Horn Island, with a view to obtaining in said pass and passage leading therefrom a channel of 23 feet at low tide.*—Major Rossell submitted report of survey December 31, 1896. He states that to obtain a channel 300 feet wide and 23 feet deep at mean low water from Horn Island Harbor to the Gulf of Mexico would require the excavation of 410,000 cubic yards of material, at an estimated cost of $102,500. To improve this channel to a width of 300 feet and depth of 21 feet at mean low water would necessitate the excavation of 85,332 cubic yards of material, at an estimated cost of $21,333. For reasons given in his report, the local officer is of the opinion that Horn Island Harbor and Pass are not worthy of being improved by the General Government, and the division engineer concurs in his views. The report was transmitted to Congress and printed in House Doc. No. 200, Fifty-fourth Congress, second session. (See also Appendix Q 16.)

4. *Survey of Pascagoula River, Mississippi, commencing at a point in the Mississippi Sound where the depth of water exceeds 17 feet, thence to the mouth of and up said river to the intersection of Dog River, and thence up Dog River 3 miles, with a view to obtaining a channel of 17 feet at low tide along the line of survey.*—Major Rossell submitted report of survey December 28, 1896. He estimates that to obtain a 17-foot channel from 3 miles above the mouth of Dog River to the 17-foot contour in Mississippi Sound, with widths of 150 feet above the railroad bridge at Scranton and 300 feet below that point, would cost $1,050,222. The permanency of the dredged channel below the railroad bridge at Scranton is an open question, and the local officer recommends that the channel be first dredged to a depth of 12 feet; after this is done and such depth is found to be reasonably permanent, then to increase the depth to 17 feet. In conformity with this recommendation an estimate amounting to $267,600 is submitted as the cost of obtaining a 12-foot channel from 3 miles above the mouth of Dog River to the 12-foot contour in Mississippi Sound, with widths similar to those provided in the estimate for a 17-foot channel. In the opinion of the division engineer the mouth and lower part of Pascagoula River are worthy of improvement to the extent of a channel 12 feet deep, but no more. The report was transmitted to Congress and printed in House Doc. No. 211, Fifty-fourth Congress, second session. (See also Appendix Q 17.)

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5. Survey of Ship Island Harbor, in the Mississippi Sound, to determine the most practicable route from said harbor for a deep-water channel leading to the mainland on the coast of Mississippi.—Major Rossell submitted report of survey January 23, 1897. In his opinion the most practicable route for the proposed channel is that leading to Biloxi; and the estimated cost of a channel to the wharves at that place from Ship Island Harbor, 300 feet in width and 23 feet deep at mean low water, is $812,500. The cost of maintenance would be about $50,000 annually. It is also his opinion, however, that the interests involved will not now justify the cost of the improvement. The division engineer concurs in the views of the local officer. The report was transmitted to Congress and printed in House Doc. No. 252, Fifty-fourth Congress, second session. (See also Appendix Q 18.)

6. Survey of channel at mouth of Pearl River, Mississippi, leading to deep water in the Mississippi Sound, with a view to obtaining a 17-foot channel at low tide.—Major Rossell submitted report of survey December 23, 1896. He submits a plan which provides for a channel 300 feet wide and 17 feet deep at mean low water, at an estimated cost of $227,599.20. For reasons given it is the opinion of the local officer that this channel is not worthy of improvement to a greater depth than 9 feet at mean low water. To obtain a channel 300 feet wide and 9 feet deep at mean low water an estimate of $18,199.80 is submitted. The channel thus obtained would be reasonably permanent. The division engineer concurs in the opinion that this channel is not worthy of improvement to a depth of 17 feet at mean low water, but is worthy of improvement to a depth of 9 feet at mean low water. The report was transmitted to Congress and printed in House Doc. No. 206, Fifty-fourth Congress, second session. (See also Appendix Q 19.)

INSPECTION OF THE IMPROVEMENT OF THE SOUTH PASS OF THE MISSISSIPPI RIVER.

The act of Congress of March 3, 1875, amended by acts of June 19, 1878, and March 3, 1879, made provision for the construction, by James B. Eads or his representatives, of jetties and other works in the South Pass of the Mississippi River, to secure and maintain a channel through the pass 26 feet deep, and through the jetties 26 feet deep and 200 feet wide at bottom, with a central depth of 30 feet. An annual payment of $100,000 was provided for the maintenance of such a channel for twenty years after first obtaining it by the works built. The required channels were secured in July, 1879.

During the year the required channel was maintained through the shoal at the head of South Pass and through the pass itself, except during thirty-seven days, when the channel in Grand Bayou Reach did not contain the required depth.

The required channel "through the jetties" and beyond them to deeper water in the Gulf was maintained during the year, except for one hundred and thirty-seven days.

During the year the dredge boat worked fifteen days in South Pass, ninety days in the jetty channel, and five days in the channel beyond the ends of the jetties.

The object of the examinations and surveys of the South Pass, the expenses of which are now provided for by the permanent indefinite appropriation made by act of August 11, 1888, is to determine if the channel is maintained as required by law and to enable an engineer officer to issue the certificates required for the quarterly payments.

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The officer in charge of these surveys is Maj. James B. Quinn, Corps of Engineers, whose annual report thereon and on work done during the year is submitted as Appendix R.

Attention is invited to the necessity of making provision for the maintenance of South Pass after the present contract expires, and also to the necessity of increasing the amount appropriated for "examinations and surveys at South Pass, Mississippi River," as explained in Major Quinn's report.

By reason of a ruling by the Treasury Department the unexpended portion of appropriation for this work remaining on hand June 30, 1896 ($1,100), was returned to the Treasury. A deficit resulted, and in order to secure the uninterrupted examinations and surveys it became necessary to request from Congress an additional appropriation of $1,000 for surveys at the mouth of Mississippi River during the present fiscal year.

The additional funds requested were provided by the deficiency act, approved July 19, 1897.

The correspondence on this subject was printed in House Doc. No. 296, Fifty-fourth Congress, second session, and is submitted herewith as a part of Appendix R.

IMPROVEMENT OF RIVERS AND HARBORS IN SOUTHERN LOUISIANA AND EASTERN TEXAS.

This district was in the charge of Maj. James B. Quinn, Corps of Engineers. Division Engineers, Col. J. W. Barlow, Corps of Engineers, to May 7, 1897, and Col. Henry M. Robert, Corps of Engineers, since that date.

1. Chefuncte (Tchefuncte) River and Bogue Falia, Louisiana.—Previous to improvement these streams were obstructed by snags, logs, etc., and there was but a depth of 4½ feet of water over the bar at the mouth at the lowest stage.

The project for the improvement was adopted in 1880 and modified in 1884, and provided for the removal of obstructions in the channel, the building of a breakwater across the bar, and the dredging of the bar.

The first two appropriations, made in 1881 and 1882, aggregating $3,000, were used in removing obstructions from below Covington and in constructing 820 feet of breakwater. The bar at the mouth was not dredged, as it would be likely to re-form. To prevent or retard its re-formation, the officer in charge in 1884 recommended building a breakwater extending 2,500 feet into the lake and then dredging a channel through the bar.

The original estimated cost of the improvement, but not including the breakwater, was $5,460.

With the appropriation of $2,500, made in 1886, channels about 5 feet in depth and 30 to 60 feet wide were cut through the bars on the Bogue Falia between Old Landing and Covington, improving the navigation for schooners to and from Covington.

Under the appropriation of $1,000, made in 1890, work with the Government snagging plant and hired labor was carried on and the river cleared of obstructions from Madisonville to Old Landing, and from the latter place to Covington, on the Bogue Falia, as far as the available funds would permit.

With the appropriation made in 1892 of $1,000 the snagging plant was extensively repaired, but no other work was done.

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The appropriation made in act of 1894 of $1,000, for maintenance, was expended in dredging channels 6 feet deep and 60 feet wide through the bars in the river below Covington, navigation being rendered available thereby for steamers drawing 5 feet from Covington, on the Bogue Falia, to the mouth of the river, a distance of 14 miles.

The amount expended to June 30, 1896, was $8,330.29.

The work done is at this time in fairly good condition.

By act of June 3, 1896, $1,000 was appropriated for maintenance of this work. Nothing has been done as yet with this amount.

It is estimated that about $1,000 annually will be required to maintain the improvement.

The amount of commerce involved is $632,894.

Receipts and shipments for two years.

Year ending May 31—	Tons.	Value.
1896	67,778	$621,454
1897	110,034	632,894
Increase	42,256	11,440

July 1, 1896, balance unexpended	$1,169.71
June 30, 1897, amount expended during fiscal year	19.00
July 1, 1897, balance unexpended	1,150.71
Amount required in fiscal year ending June 30, 1899, for maintenance... Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	1,000.00

(See Appendix S 1.)

2. Tickfaw River and its tributaries, Louisiana.—The primary project for the improvement of the Tickfaw River and its tributaries (Natalbany, Blood, and Ponchatoula rivers) was adopted in 1881, and provided for the removal of obstructions from the streams at an estimated cost of $10,230.

Under this project the improvement was carried on from 1881 to February 5, 1895, with appropriations aggregating $10,000, resulting in the improvement of about 30 miles of the Tickfaw River and its branches.

For details as to history, progress, and general results obtained by the work done under these appropriations, see Appendix R, Annual Report of the Chief of Engineers for 1895, pages 1744 and 1787.

The amount expended on this improvement to June 30, 1896, was $9,876.14.

Under the appropriation of $1,000 made by act of June 3, 1896, a contract was entered into for hire of a boat for use in removing the water lilies or hyacinths with which the stream had become clogged. Work under this contract was commenced at the mouth of the river on February 26, 1897, and ceased on March 31, 1897, and resulted in the removal of the water lilies or hyacinths from about two miles of the stream, at a cost of $960, but the aquatic plants came floating into the channel space, and conditions were almost as bad, in a short time, as before operations were commenced.

There was expended on this work during the fiscal year ending June 30, 1897, the sum of $976.92. The total expenditure on this improvement to June 30, 1897, was $10,853.06.

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The amount of commerce involved in this improvement is $336,370.

It is estimated that $1,000 will be required annually for maintenance of the improvement.

Comparative statement of receipts and shipments for six years.

Year ending May 31—	Tons.	Value.	Year ending May 31—	Tons.	Value.
1892	11,407	$102,116	1895	23,384	$220,566
1893	13,994	169,643	1896	72,851	353,246
1894	40,003	251,774	1897	58,115	336,370

July 1, 1896, balance unexpended	$1,123.86
June 30, 1897, amount expended during fiscal year	976.92
July 1, 1897, balance unexpended	146.94
Amount required in fiscal year ending June 30, 1899, for maintenance. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	1,000.00

(See Appendix S 2.)

3. Amite River and Bayou Manchac, Louisiana.—Before improvement was commenced the Amite River and Bayou Manchac, its principal tributary, was navigable by the ordinary river steamer below and for a short distance above their point of junction, but the navigation was much impeded and endangered by obstructions.

In accordance with project adopted in 1880 obstructions were removed in 1890 and 1891 from the river from its mouth to the junction with the bayou, and from the bayou between the mouth and Hope Villa, the extent of channel improved being 13 miles.

With the appropriations of 1892 and 1894 for maintenance, aggregating $5,000, of which $1,000 was to be used in the construction of a turning basin for boats at the mouth of Wards Creek on Bayou Manchac, the work of removal of obstructions was continued.

The turning basin for boats at the mouth of Wards Creek on the bayou was completed in January, 1895, and vessels drawing 5 feet can find sufficient depth of water from this point to the mouth of the Amite River.

A detailed history of this improvement may be found in Appendix R, Annual Report of the Chief of Engineers for 1896, pages 1490 and 1491.

There were no operations on this improvement during the fiscal year ended June 30, 1897, but the available funds will probably be expended in removal of obstructions which have formed since the work done in 1895.

The amount expended on these streams to June 30, 1896, was $28,473.63.

An appropriation of $2,500 for maintenance was made in act of June, 1896. It is estimated that this amount will be required annually for maintenance of the improvement.

The amount of commerce involved in this improvement amounts to $516,443.

Comparative statement of receipts and shipments for eight years.

Year ending May 31—	Tons.	Value.	Year ending May 31—	Tons.	Value.
1890	84,295	$291,967	1894	157,902	$796,305
1891	17,792	300,963	1895	42,983	491,216
1892	18,530	334,061	1896	55,103	414,245
1893	22,099	346,257	1897	49,509	516,443

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July 1, 1896, balance unexpended	$2,826.37
June 30, 1897, amount expended during fiscal year	16.67
July 1, 1897, balance unexpended	2,809.70
July 1, 1897, outstanding liabilities	4.50
July 1, 1897, balance available	2,805.20
Amount required in fiscal year ending June 30, 1899, for maintenance. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	2,500.00

(See Appendix S 3.)

4. Bayou Lafourche, Louisiana.—Prior to improvement this stream was badly obstructed by snags, logs, etc. The first project for its improvement was adopted in 1879 and had for its object the removal of these obstructions, and operations under this project were carried on, with appropriations aggregating $30,000, until 1885.

A project submitted on June 11, 1886, contemplated the establishment of a lock at the head of the bayou connecting it with the Mississippi River, and provided for subsequent dredging to secure a channel 75 feet wide and 5 feet deep at mean low water of the Gulf, the estimated cost being $450,000, with an annual expenditure of $8,000 for maintenance and operation.

By act of August 11, 1888, the sum of $50,000 was appropriated for the improvement of the bayou under this plan, and providing also for immediate dredging for the relief of low-water navigation. Dredging was begun at the head of the bayou, and has been continued since at intervals, under appropriations aggregating $165,000, up to February 13, 1897.

Work under the contract approved June 16, 1896, was commenced on the bar at the head of the bayou on July 6, 1896, and was continued down the bayou to a point about 3 miles above Thibodaux, and resulted in the improvement of about 38 miles by dredging and removal of obstructions. During progress of the work 135,510 cubic yards of material, 34 logs, 6 wrecks, 8 snags, 2 stumps, and several log jams, caused by flatboat wrecks accumulating the drift, were removed.

These operations have been of great benefit to the commerce of the bayou; sufficient water for navigation of the bayou prevailed during the entire low-water season.

A project was approved September 23, 1896, modifying the project of 1886, providing that the lock matter be held in suspension and operations be confined to dredging for the purpose of maintaining low-water navigation, the estimated cost of this maintenance being $25,000 per annum.

The total amount expended on this improvement to June 30, 1896, was $168,857.92.

The commerce involved in this improvement amounts to $4,988,875.

Comparative statement of receipts and shipments for eight years.

Year ending May 31—	Tons.	Value.	Year ending May 31—	Tons.	Value.
1890	200,746	$5,709,382	1894	273,686	$8,842,942
1891	217,273	8,244,225	1895	263,607	9,224,554
1892	171,885	5,660,662	1896	229,891	5,629,237
1893	212,476	7,422,285	1897	217,292	4,988,875

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July 1, 1896, balance unexpended	$76,142.08
June 30, 1897, amount expended during fiscal year	16,129.98
July 1, 1897, balance unexpended	60,012.10
July 1, 1897, outstanding liabilities	80.10
July 1, 1897, balance available	59,932.00
Amount required in fiscal year ending June 30, 1899, for maintenance. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	25,000.00

(See Appendix S 4.)

5. Bayou Plaquemine, Grand River, and Pigeon bayous, Louisiana.—Previous to the closing of the mouth of Bayou Plaquemine in 1867 or 1868, by a dam built by order of the police jury of Iberville Parish and shutting out the waters of the Mississippi River, the largest steamboat passed through it into Grand Lake and the water routes connected with it.

The original project for the improvement, adopted in 1885, contemplated only the dredging and cleaning out of Bayou Plaquemine and building of a lock at the head of the bayou.

In 1888 the protection of the bank of the Mississippi River at Plaquemine Bend was made a part of the improvement. On account of lack of plant the bank work was transferred to the fourth district of the Mississippi River Commission in May, 1889, and after its completion was again transferred to this office on September 28, 1894.

By act of July 13, 1893, the improvement of Grand River and Pigeon bayous was made a part of this improvement.

The appropriations by the act of 1888 and later acts were used in bank protection and in dredging a channel 60 feet wide and 6 feet deep at mean low-water level of the Gulf and for work on the Grand River and Pigeon Bayou routes, which latter was carried on in 1893, 1894, and 1895, and extended the improvement down to Grand Lake, a distance of 25 miles.

In 1891 a project was submitted for the construction of a lock, but actual construction was delayed for lack of funds. A contract for construction of cofferdam and excavating and piling foundation for lock was entered into June 24, 1895, and the work was commenced on September 1, 1895. The contractor has been meeting with many unforeseen obstacles. A severe storm in June, 1896, washed a large portion of the excavated material back into the pit. In August, 1896, a dangerous movement in the slopes on the end of the pit near the river and other movements of earth necessitated the excavation of a large quantity of material not contemplated in the original contract.

Authority for the making of a supplemental contract, at regular contract prices, was granted February 12, 1897, and under it 40,850 cubic yards of material has been removed. Under the original contract thirty-one fiftieths of the piles for the foundation of the lock have been driven.

Owing to the unusually high water of this year a complete reconstruction of the lock plans has become necessary, and these will be ready shortly. So soon as approved a contract for the completion of the lock will be awarded under the provisions of continuing-contract system contained in the act of June 3, 1896.

The improvement of Grand River and Pigeon bayous, under contract approved February 1, 1897, was begun March 26, 1897, and up to the close of the fiscal year 38,835 cubic yards of material has been dredged, 1,700 stumps and snags, 33 overhanging trees, and many logs have been removed.

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The total amount expended on this improvement to June 30, 1896, was $359,412.76.

The value of the commerce involved is $209,586, and the amount expended on this improvement to June 30, 1897, was $396,025.40.

COMMERCIAL STATISTICS.

Comparative statement of receipts and shipments for six years.

Year ending May 31—	Tons.	Value.	Year ending May 31—	Tons.	Value.
1892	131,875	$1,343,608	1895	120,542	$1,110,130
1893	78,756	1,174,750	1896	92,379	284.175
1894	133,752	555,677	1897	57,055	209,586

July 1, 1896, balance unexpended		$120,587.24
Amount appropriated by sundry civil act approved June 4, 1897		350,000.00
		470,587.24
June 30, 1897, amount expended during fiscal year		36,612.64
July 1, 1897, balance unexpended		433,974.60
July 1, 1897, outstanding liabilities	$16,364.86	
July 1, 1897, amount covered by uncompleted contracts	29,893.85	
		46,258.71
July 1, 1897, balance available		387,715.89
Amount (estimated) required for completion of existing project		878,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		450,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix S 5.)

6. Bayou Courtableau, Louisiana.—When the present project was adopted, a large deposit of sand, known as Little Devil Bar, had been formed at the mouth of the bayou by the backwater from the Atchafalaya River.

The project of 1880 had for its object the closing of some run-out bayous, throwing all the water into the channel of the Courtableau, and causing its current to wash out the bar at its mouth.

Work was carried on under appropriations made from time to time, aggregating $36,200, and the project was completed November 9, 1895.

In 1891, during the season of low water, the dams were all placed in thorough repair.

An appropriation of $5,000 was made by act of 1894 for continuing this improvement, the approved project under the appropriation looking to the closure of bayous Fordoche, Mamzelle, Big and Little Cane, and if funds would permit to close the small bayous between bayous Mamzelle and Big Cane. This work was done by contract and was finished on November 9, 1895.

During the high water of 1896 the backwater from the Atchafalaya River and the current from the Courtableau caused the formation of a large raft of logs a short distance above the mouth of the bayou, forming a complete obstruction to navigation.

Proposals were invited for the removal of this raft, but no satisfactory bids were received.

A proposition submitted by Mr. Ed. C. Pearson, of New Orleans, La., in which he proposed to make a channel of at least 60 feet in width through this raft for the sum of $2,500, the cost of the work to be borne by himself in the event of failure to complete the channel as specified,

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was accepted with the stipulation that the agreement should remain in force until February 28, 1898. Mr. Pearson has not made any arrangements to carry out the provisions of his accepted proposition, and there does not appear to be any probability of his making any.

It is doubtful whether the removal of the raft can be effected without the expenditure of a sum much in excess of that at present available. It might even be avisable to abandon the proposed removal of the raft and adopt other methods of restoring communication between the Courtableau and the Atchafalaya.

As the situation is now, no further sums for maintenance will be needed unless the removal of the raft can be accomplished.

To June 30, 1896, there had been expended on this improvement the sum of $35,425.61.

The value of commerce involved in this improvement is $103,944, as shown by the commercial statistics forwarded with the annual report of 1886. There was no commerce on this stream during the last fiscal year, owing to the obstruction of navigation caused by raft of logs in its channel.

Comparative statement of receipts and shipments for seven years.

Year ending May 31—	Tons.	Value.	Year ending May 31—	Tons.	Value.
1890	25,867	$4,629,584	1894	9,195	$485,811
1891	32,618	3,917,344	1895	4,095	160,787
1892	20,041	994,471	1896	1,994	103,944
1893	14,848	677,529			

There was no commerce on Bayou Courtableau last year.

July 1, 1896, balance unexpended	$3,274.39
June 30, 1897, amount expended during fiscal year	28.85
July 1, 1897, balance unexpended	3,245.54
July 1, 1897, amount covered by uncompleted contracts	2,500.00
July 1, 1897, balance available	745.54

(See Appendix S 6.)

7. Bayou Teche, Louisiana.—The channel had a depth of 8 feet previous to improvement, but it was obstructed and unsafe for navigation. The first project adopted contemplated the removal of these obstructions, and, under the appropriations (six in number) made from 1870 to 1894, 70 miles of the channel was improved; but the results were not permanent, the obstructions again forming.

For details as to history, progress, and general results obtained by the work done under these appropriations, see Appendix R, Annual Report of the Chief of Engineers for 1896, pages 1503 and 1504.

The amount expended on this improvement to June 30, 1896, was $60,972.56.

Under appropriation of $10,000, made by the act of June 3, 1896, dredging and snagging operations, under contract, were commenced on November 16, 1896, and continued until March 22, 1897. Under this contract 64,593 cubic yards of material was dredged and 1,665 obstructions, consisting of overhanging trees and limbs, sunken logs, snags, etc., were removed. A channel 60 feet wide and averaging 5 feet in depth has been secured between St. Martinville and Charenton, a distance of 44½ miles.

This is a very important improvement, the amount of commerce involved being $4,103,724.

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Receipts and shipments for two years.

Year ending May 31—	Tons.
1896	293,685
1897	303,029
Increase	9,344

July 1, 1896, balance unexpended	$10,027.44
June 30, 1897, amount expended during fiscal year	9,607.11
July 1, 1897, balance unexpended	420.33

(See Appendix S 7.)

8. *Channel, bay, and passes of Bayou Vermilion, Louisiana.*—The first project for this improvement, approved in 1892, provided for the removal of obstructions from the bayou and the marking of the channel in the bay with guide piles, at an estimated cost of $25,000.

Under this project work was carried on from December 1, 1892, to August 27, 1895, with the various appropriations made from time to time, amounting to $12,500, resulting in the marking of the channel through the bay with guide piles and the removal of obstructions from a point 18 miles above the mouth of the bayou to a point 26 miles above Abbeville, La.

For details as to history, progress of the work, and results obtained by the improvement, see Appendix R, Annual Report of Chief of Engineers for 1896, pages 1505 and 1506.

There was expended on this improvement to June 30, 1896, the sum of $12,365.63.

The sum of $1,000 was appropriated by act of June 3, 1896, for continuance of this improvement, and this amount will probably be used in removing obstructions in the bayou, which have formed since the completion of the operations in August, 1895.

The amount of commerce involved in this improvement is $282,892.

Comparative statement of receipts and shipments for five years.

Year ending May 31—	Tons.	Value.	Year ending May 31—	Tons.	Value.
1893	35,671	$1,277,365	1896	13,022	$355,136
1894	43,882	923,777	1897	6,112	282,892
1895	12,993	429,172			

July 1, 1896, balance unexpended	$1,134.37
June 30, 1897, amount expended during fiscal year	21.95
July 1, 1897, balance unexpended	1,112.42
Amount (estimated) required for completion of existing project	11,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	11,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix S 8.)

9. *Mermentau River and tributaries, Louisiana.*—The first project for the improvement of this river was adopted in 1892, and provided for the removal of snags, logs, etc., in the upper river and a mud flat in the lower, at an estimated cost of $23,615.25, and $7,500 was appropriated by act of July, 1892, for the work.

Work was commenced December 8, 1892, and carried on from the lower end of Lake Arthur up the Mermentau River, 38 miles of channel being improved.

An appropriation of $5,000 was made in 1894 for continuing the

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improvement and a project was submitted, but it was not deemed prudent to undertake this work with the funds then available, the amount being insufficient to accomplish anything of a substantial character.

On June 3, 1896, Congress appropriated $5,000 for the continuation of this improvement, and a project was approved June 15, 1897, providing for dredging and the construction of brush dams to secure a channel through Mud Lake.

A detailed history of this improvement may be found in Appendix R, Annual Report of the Chief of Engineers for 1896, pages 1507 and 1508.

No field work under this improvement was done during the fiscal year ending June 30, 1897; the amount expended was for clerk hire and for collecting commercial statistics.

There had been expended on this improvement to June 30, 1896, the sum of $7,121.42.

The amount of commerce involved in this improvement is $278,286.

Comparative statement of receipts and shipments for five years.

Year ending May 31—	Tons.	Value.	Year ending May 31—	Tons.	Value.
1893	16,250	$324,900	1896	16,459	$206,777
1894	5,437	188,950	1897	12,210	278,286
1895	15,955	300,163			

July 1, 1896, balance unexpended	$10,378.58
June 30, 1897, amount expended during fiscal year	190.65
July 1, 1897, balance unexpended	10,187.93
Amount (estimated) required for completion of existing project	6,115.25
Amount that can be profitably expended in fiscal year ending June 30, 1899	6,115.25
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix S 9.)

10. Mouth and passes of Calcasieu River, Louisiana.—There was a depth of but 3 feet over the bars in Calcasieu Lake prior to improvement. A channel 8 feet deep and 70 feet wide, and having a length of 7,500 feet, was dredged through the bars in Calcasieu Lake above Calcasieu Pass in 1874, 1882, and 1883. In 1885 this channel had shoaled to a depth of 3½ feet.

Contracts were entered into in 1886 for the building of two revetment walls and the dredging of a channel between them; the contract also provided for the dredging of a channel through the bar at the mouth of Calcasieu River, at the northern end of the lake, 100 feet wide and 6 feet deep. The contract was annulled in January, 1888, and the project modified so as to omit the revetment.

Work was commenced with the Government dredge March 19, 1888, and carried on till August 31, 1888. The material taken out amounted to 77,159 cubic yards.

In 1888 the sum of $10,000 was appropriated for continuing the improvement, and in 1890 an appropriation of $75,000 was made for "improving the mouth and passes of Calcasieu River," according to the plan reported by Major Heuer, Corps of Engineers, in 1886, and confirmed by Captain Fisk, Corps of Engineers, in his report of November, 1888. The amounts available being considered to be too small to commence operations economically, they were held for further increase.

An additional sum of $100,000 was appropriated in 1892, and a contract was let for the construction of a jetty on the east side of the channel across the bar at the mouth of the pass and for 10,000 linear

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feet of revetment for the northern side of a channel to be dredged through the bar at the head of the pass. The revetment was completed August 6, 1893; the dredging was finished in November, 1894, and was done with the Government dredge. This work completed the channel at the foot of Calcasieu Lake.

The channel secured by the dredge has given considerable relief, and vessels drawing 6½ feet pass through it with safety.

The contractors completed their work on the east jetty on August 11, 1894, when it was 7,347 feet in length.

The project approved August 17, 1894, and under which the work is at present being conducted, contemplates dredging channels through the bar at the head of Calcasieu Lake, the capping of 7,000 feet of the east jetty with stone, and using the balance unexpended in dredging a channel 12 feet deep from the 12-foot contour inside to the 12-foot contour outside; channel to be as wide as funds would permit.

Dredging was carried on at the head of the lake from November 5, 1894, to June 30, 1895, giving an available channel 50 feet wide and 8 feet deep.

Under the appropriation of $90,000 made in 1894 a contract was entered into for capping the east jetty with stone. Work under this contract was begun January 28, 1895, and finished August 8, 1895, 9,595.64 tons of capping blocks being used and 6,552 linear feet of jetty being capped.

Work under contract approved March 2, 1896, for extending east jetty was commenced in May, 1896, and finished on August 4, 1896, giving the east jetty on completion a total length of 7,847 feet.

Under the appropriation of June 3, 1896, of $80,000, a contract for building the west jetty was executed, the work under it being commenced January 1, 1897, and completed June 15, 1897, resulting in the construction of 2,200 feet of the west jetty, 1,275 linear feet of which has been completed and capped, and 875 linear feet brought up to mean high water and ready for capping. The remainder, 100 feet, is foundation work only.

A recent survey showed the depth on the bar at the outer pass to be 7 feet at mean low water. There is an available depth through the channel in the lake of about 6½ feet.

The amount expended on this improvement to June 30, 1896, was $295,545.86.

The value of the commerce involved is $664,870.

Comparative statement of receipts and shipments for five years.

Year ending May 31—	Tons.	Value.	Year ending May 31—	Tons.	Value.
1893	207,545	$2,141,750	1896	202,775	$691,542
1894	344,973	1,600,574	1897	141,029	664,870
1895	254,394	788,274			

July 1, 1896, balance unexpended	$105,954.14
June 30, 1897, amount expended during fiscal year	91,066.91
July 1, 1897, balance unexpended	14,887.23
July 1, 1897, outstanding liabilities	7.50
July 1, 1897, balance available	14,879.73
Amount (estimated) required for completion of existing project	255,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	255,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix S 10.)

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11. Harbor at Sabine Pass, Tex.—Originally there was a less depth than 6 feet of water over the bar at the entrance to this harbor. The project of 1882 provided for constructing jetties on either side of the channel connecting the deep water of the pass with that of the Gulf, at an estimated cost of $3,177,606.50.

With the appropriations made from time to time work has been carried on under various contracts.

On June 30, 1896, the west jetty was 14,875 feet long, 6,609 feet of which being raised to 2 feet above mean high water, 7,966 feet to mean low water, the remaining 300 feet being foundation work.

The east jetty then had a total length of 19,500 feet, 17,100 feet of which had been completed.

The dredged channel had an average width of 100 feet and a depth of 24 feet.

During the year just closed there has been expended on this improvement the sum of $38,701.49, and has resulted in adding 3,652.82 tons of granite riprap stone and 3,002.68 tons of granite capping blocks to the east jetty.

On June 30, 1897, the east jetty had a total length of 19,500 feet, 18,600 feet of which having been completed, 600 feet brought up to mean low water, the remaining 300 feet being foundation work.

No work was done during the past year on the west jetty nor on the channel.

The dredged channel has an approximate width of 100 feet and a depth of from 20 to 27 feet. The resurvey shows that only in one place was a depth of 20 feet found, and even at this place vessels drawing 22 feet experience no difficulty, as the bottom is of very soft material.

As authorized by the act of June 3, 1896, a continuing contract was entered into May 10, 1897, for such materials and labor necessary to complete the present project of improvement, the contract to expire May 31, 1901.

The sum of $350,000 was appropriated by the sundry civil act of June 4, 1897, for expenditure under the continuous contract, and $100,000 was provided by the same act for the purchase of a dredge and $30,000 for its operating expenses during the next year. Advertisements inviting bids for furnishing the dredge have been approved, and the boat will be procured at the earliest date practicable.

COMMERCIAL STATISTICS.

Comparative statement of receipts and shipments for six years.

Year ending May 31—	Tons.	Value.	Year ending May 31—	Tons.	Value.
1892	38,028	$225,963	1895	47,691	$252,823
1893	15,050	180,950	1896	48,886	199,042
1894	40,966	280,189	1897	87,632	475,288

Comparative statement of tonnage and value for 1896–97.

Year ending May 31—	Tons.	Value.
1897	87,632	$475,288
1896	48,886	199,042
Increase	38,746	276,246

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July 1, 1896, balance unexpended		$111,207.98
Amount appropriated by sundry civil act approved June 4, 1897		480,000.00
		591,207.98
June 30, 1897, amount expended during fiscal year		38,701.49
July 1, 1897, balance unexpended		552,506.49
July 1, 1897, outstanding liabilities	$132.51	
July 1, 1897, amount covered by uncompleted contracts for fiscal year 1898	[1]350,000.00	
		350,132.51
July 1, 1897, balance available		202,373.98
Amount (estimated) required for completion of existing project		1,028,856.50
Amount that can be profitably expended in fiscal year ending June 30, 1899		450,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix S 11.)

12. Sabine River, Texas.—Before improvement there was a depth of 3½ feet of water over the bar at the mouth of the river and above the town of Orange.

The original estimated cost of this improvement was $18,000, and provided for the removal of obstructions such as logs, snags, etc.

With the appropriation of $10,000 made in act of 1878, a channel 6 feet deep and 70 to 100 feet wide was dredged through the bar at the mouth.

A further appropriation of $6,000 was made by act of 1879, and provided for a resurvey of the river. It was decided to improve the river above Orange, and cuts were made from the main river into the Narrows and at Dead Bend, and a number of obstructions were removed from the Narrows, enabling vessels of 5-foot draft to get 30 miles above Orange.

With the appropriations made by acts of 1880 and 1881, aggregating $12,000, the bar at the mouth was redredged to a depth of 6 feet and the channel made 100 feet wide, extending a little over a mile, the work being completed in 1882.

An examination made in 1889 showed that the channel was obstructed, especially in the Narrows. The appropriation made in act of 1882 being available, a project was approved for the removal of obstructions and closure of the two branches of Old River, throwing the water into the Narrows. This work was done by contract and was completed in December, 1890.

Under the project approved in 1892 and with the appropriation made by act of 1892, about 17½ miles of channel was freed from obstructions. This work was done by contract.

The sum of $5,000 was appropriated by act of 1894 for completing the project of 1892, and work under contract commenced in July, 1895, and continued to October, 1895, resulting in the improvement of the river from Morgans Bluff to Cypress Bayou, a distance of 20 miles, leaving the river in fairly good condition up to Sudduths Bluff.

The sum of $4,000 was allotted by act of 1895, from the appropriation for improving Sabine Pass, for dredging across the bar at the mouth of the river. This work was done by the Government dredge, and resulted in the completion of a channel 50 feet wide and 8 feet deep from deep water in Sabine River to deep water in the lake.

An examination made in May, 1897, of the dams built in 1890 and of

[1]The approved continuous contract calls for the expenditure of $1,050,000.

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that part of the stream cleared in 1895 showed both to be in good condition.

Work under project approved June 9, 1897, which proposes the removal of obstructions existing between Morgans Bluff and the head of the Narrows, will be commenced in the coming year, with the appropriation of $2,000 made in act of June 3, 1896.

The amount expended on this improvement to June 30, 1896, was $48,560.62.

The amount of commerce involved in this improvement is $1,181,154.

It is estimated that $2,000 will be required annually for maintenance of the improvement.

Comparative statement of receipts and shipments for five years.

Year ending May 31—	Tons.	Value.	Year ending May 31—	Tons.	Value.
1893	146,363	$1,591,280	1896	271,257	$979,380
1894	245,657	1,518,630	1897	245,864	1,181,154
1895	182,738	736,044			

July 1, 1896, balance unexpended	$2,139.38
June 30, 1897, amount expended during fiscal year	13.15
July 1, 1897, balance unexpended	2,126.23
Amount required in fiscal year ending June 30, 1899, for maintenance. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	2,000.00

(See Appendix S 12.)

13. Neches River, Texas.—In 1895 a project was adopted providing for the expenditure of the balance available for this work, about $4,000, in dredging a 6-foot channel 100 feet in width from deep water in the Neches River to that in Sabine Lake. The work was finished in May, 1896, as projected.

For details in connection with this improvement, and history of the work, see Annual Report of the Chief of Engineers for 1896, pages 1518–1519.

COMMERCIAL STATISTICS.

Receipts and shipments for two years.

Year ending May 31—	Tons.	Value.
1897	155,378	$418,005
1896	137,268	324,075
Increase	18,110	93,930

Comparative statement of receipts and shipments for five years.

Year ending May 31—	Tons.	Value.	Year endining May 31—	Tons.	Value.
1893	77,533	$600,410	1896	137,268	$324,075
1894	165,528	593,754	1897	155,378	418,005
1895	146,618	544,720			

July 1, 1896, balance unexpended	$127.30
June 30, 1897, amount expended during fiscal year	127.30

(See Appendix S 13.)

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14. Closing crevasse in Pass a Loutre, Mississippi River.—A project for the closure of the crevasse, submitted on March 24, 1897, was approved by the Secretary of War, July 16, 1897, and work under it will be commenced at the earliest practicable date.

The field work of a survey was completed on June 30, 1897.

Amount appropriated by act approved February 26, 1897	$250,000.00
July 1, 1897, balance unexpended	250,000.00
July 1. 1897. outstanding liabilities	135.44
July 1, 1897, balance available	249,864.56

(See Appendix S 14.)

15. Removing sunken vessels or craft obstructing or endangering navigation.—An allotment of $1,500 was made for removing a sunken barge in Lake Pontchartrain. Contract was entered into for its removal for the sum of $345. Operations were commenced May 5, 1897, and were continued up to June 30, resulting in the removal of the sides and decking of barge and the piling that had been driven around the wreck by the owners. The bottom has not yet been removed.

The total amount expended during the year on removal of wrecks was $226.67.

(See Appendix S 15.)

EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The preliminary examinations and surveys of the following localities, required by the act of June 3, 1896, were made by the local engineer, Maj. James B. Quinn, Corps of Engineers, and reports thereon submitted through the division engineer, Col. J. W. Barlow, Corps of Engineers:

1. Preliminary examination of Homochitto River, Mississippi, from mouth to Yazoo and Mississippi Valley Railroad.—Major Quinn submitted report of examination January 16, 1897. It is his opinion that this portion of the river is worthy of improvement by the General Government. At the time the examination of Homochitto River authorized by the act of July 13, 1892, was made, the division engineer expressed the opinion, concurred in by the Chief of Engineers, that this stream was not worthy of improvement, and in transmitting the present report of examination Colonel Barlow states that no important reasons have been advanced since the submission of the former report, dated December 7, 1892, that would justify the Government in undertaking the improvement of the river. Inasmuch as the interests involved would appear to justify the clearing out of obstructions, provided the same can be accomplished at a proper cost, it is recommended that such further examination be made and estimate of cost prepared as will permit a full consideration of the relation of costs to interests involved. Major Quinn reports that the cost of the improvement can be estimated from data at hand. The report was transmitted to Congress and printed in House Doc. No. 290, Fifty-fourth Congress, second session. (See also Appendix S 16.)

2. Examination of channel through Atchafalaya Bay, Louisiana, with a view to ascertaining its nature and character and of determining its value and necessity to commerce.—Major Quinn submitted report of examination April 10, 1897. He states that the channel is of little or no value to navigation, and in the event of the Government desiring to open a channel between the Atchafalaya River and the Gulf it is doubtful

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whether it could be used to any advantage. Its owners do not consider the channel of sufficient value to warrant their fixing a price for it. The division engineer remarks that it is apparent from the report of the local officer that the acquisition of said channel by the United States is inexpedient and undesirable. The report was transmitted to Congress and printed in House Doc. No. 27, Fifty-fifth Congress. first session. (See also Appendix S 17.)

3. Preliminary examination of Bayou Grossetete, Louisiana.—Major Quinn submitted report of examination January 16, 1897. It is his opinion that the bayou is worthy of improvement by the General Government, and his views are concurred in by the division engineer, who recommends that the snags, stumps, and trees be removed, provided the four bridges obstructing the navigation of the bayou be so altered by their owners as to render them unobstructive. The views and recommendations of these officers are concurred in by the Chief of Engineers. No survey is required for the preparation of plan and estimate of cost of improvement. The report was transmitted to Congress and printed in House Doc. No. 280, Fifty-fourth Congress, second session. (See also Appendix S 18.)

4. Survey of Bayou Teche from St. Martinville to Port Barre, La.—Major Quinn submitted report of survey May 7, 1897. The plan of improvement proposed provides for securing a 6-foot navigation between St. Martinville and Port Barre, by the construction of two locks in the Teche, one to be located below St. Martinville and the other below the mouth of Bayou Fusileer, and contemplates certain other constructions and dredging. The cost is estimated at $245,086. It is the opinion of the local officer, concurred in by the division engineer, that Bayou Teche is worthy of improvement to the extent indicated. The report was transmitted to Congress and printed in House Doc. No. 69, Fifty-fifth Congress, first session. (See also Appendix S 19.)

5. Survey of Sabine Lake, Texas, with a view of obtaining through said lake a ship channel of sufficient width and depth for the purpose of navigation from Sabine Pass to the mouths of the Neches and Sabine rivers.—Major Quinn submitted report of survey February 3, 1897. It is estimated that a channel 25 feet deep with bottom width of 100 feet through the lake would cost $4,117,800; a channel of similar width having a depth of 12 feet would cost $2,900,000. The work of securing either of these channel dimensions involves dredging and construction of guard locks and revetments. An 8-foot channel depth with bottom width of 150 feet, requiring dredging and revetment construction, would cost $550,000, and could be maintained by an expenditure of $20,000 per year. An estimate of $20,000 is also submitted as the cost of securing a channel 6 feet deep. The report was transmitted to Congress and printed in House Doc. No. 299, Fifty-fourth Congress, second session. (See also Appendix S 20.)

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN TEXAS.

This district was in the charge of Maj. A. M. Miller, Corps of Engineers, having under his immediate orders Lieut. William V. Judson, Corps of Engineers, to February 25, 1897, and Lieut. Charles S. Riché, Corps of Engineers, since June 20, 1897. Division Engineers, Col. J. W. Barlow, Corps of Engineers, to May 7, 1897, and Col. Henry M. Robert, Corps of Engineers, since that date.

1. Galveston Harbor, Texas.—Galveston Harbor embraces an anchorage area of over 1,960 acres, of which 1,500 acres has a depth of more than 20 feet and 460 acres has a depth of more than 30 feet. It affords

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vessels excellent shelter from storms. Waterways connect it with Houston and with Brazos River.

The entrance to this harbor was originally obstructed by two bars, known as the inner and outer. The natural depth on the inner bar was about 9½ feet, and on the outer bar about 12 feet. These shallow depths prevented all but the lightest draft vessels from using the harbor and necessitated the lighterage of cargoes to the larger vessels anchored in the deep water beyond the outer bar.

Prior to 1874 the projects for improving this harbor related to dredging operations on a small scale and were only expected to afford temporary relief to navigation.

The original project for the permanent improvement of this harbor was adopted June 23, 1874, and contemplated the construction of jetties, which were expected to deepen the channel on the bar to 18 feet, the cost being estimated at $1,759,400. (See Annual Report of the Chief of Engineers for 1874, p. 722 et seq.) The method used in jetty construction having proved unsatisfactory, the subject of the improvement was referred to a Board of Engineers, who, on June 7, 1880, formulated a modified project, which also contemplated the building of jetties at a cost of $1,825,813. It was expected that upon their completion a least depth of 25 feet would be obtained on the outer bar. (See Annual Report of the Chief of Engineers for 1880, p. 1221 et seq.) On February 20, 1886, a Board of Engineers again considered the subject of this improvement and adopted a modified project which had in view a possible depth of 30 feet by constructing the jetties to a height of 5 feet above mean low tide and extending them to the 30-foot contour in the Gulf and to supplement the action of the tidal scour by dredging. The estimated cost of this revised project was $7,000,000, in addition to sums previously spent, which amounted to $1,478,000, making the aggregate cost of this improvement $8,478,000. (See Annual Report of the Chief of Engineers for 1886, p. 1294 et seq.)

The total amount expended under the foregoing plans to June 30, 1896, was $6,910,103.42, with an additional sum of $100,000 subscribed by the city of Galveston in 1883.

This expenditure resulted in a depth of 22 feet at mean low tide on the outer bar, an increase of 10 feet since work began, and a depth of 24¼ feet at mean low tide on the inner bar, an increase of 14¼ feet during the same period. This increased depth of water enabled most vessels to load to their full capacity at the Galveston wharves, thereby making the lighterage of cargoes no longer necessary.

The expenditure during the fiscal year ending June 30, 1897, was $991,261.47, and resulted in a further deepening of the water on the outer bar to 24¾ feet and on the inner bar to 25¼ feet, also in a widening and straightening of the channel between the jetties.

At the end of the fiscal year the south jetty had been completed for a length of 34,800 feet and partially completed for 800 feet. On the same date the north jetty had been completed for a length of 24,700 feet and partially completed for 1,207 feet.

Commerce has been greatly benefited by the improvement of this harbor, as shown by the increased size and tonnage of the vessels using the port and in the large increase (437,226 tons) in the amount of freight handled.

The total amount of ocean commerce transported to and from Galveston during the fiscal year was 1,209,822 tons, divided as follows: Cotton and cotton products, 541,145 tons; grain, 272,340 tons; coal, 142,092 tons; wool, 5,423 tons; ore, 12,473 tons; sugar, 1,133 tons; and general merchandise, 235,216 tons.

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July 1, 1896, balance unexpended		$1,068,196.58
Amount appropriated by sundry civil act approved June 4, 1897		500,000.00
		1,568,196.58
June 30, 1897, amount expended during fiscal year		991,261.47
July 1, 1897, balance unexpended		576,935.11
July 1, 1897, outstanding liabilities	$114,747.02	
July 1, 1897, amount covered by uncompleted contracts	291,090.87	
		405,837.89
July 1, 1897, balance available		171,097.22

(See Appendix T 1.)

2. Ship channel in Galveston Bay, Texas.—Galveston Bay is a large body of water, covering an area of about 455 square miles, and is situated north of the eastern end of Galveston Island and of Bolivar Peninsula. It is connected with the Gulf of Mexico by Bolivar Channel and merges into West Galveston Bay at its southwestern extremity. Several rivers and bayous empty into the northern portion, and it was for the purpose of giving the commerce of those streams an outlet to the Gulf of Mexico that the dredging of a channel through the bay was undertaken. The natural depth along the line of the proposed channel varied from 4 to 8½ feet.

The project, adopted June 10, 1872, proposed dredging a channel 100 feet wide and 6 feet deep across Red Fish and Cloppers bars, at a cost of $62,805. (See Annual Report of the Chief of Engineers for 1871, p. 533 et seq.) The river and harbor act of August 14, 1876, provided for a survey for a ship channel through Galveston Bay from 12 feet of water in the mouth of San Jacinto River * * * to 12 feet of water in Galveston channel. This survey resulted in a modified project being adopted on May 21, 1877, which had in view the dredging of a channel 100 feet wide at bottom and 12 feet deep through Galveston Bay from the lower end of Morgan Cut to Bolivar Channel, the cost being estimated at $446,326.42. (See Annual Report of the Chief of Engineers for 1877, p. 456 et seq.) In 1888 this amount was increased to $740,108.22, the former estimate having been found to be inadequate. (See Annual Report of the Chief of Engineers for 1888, p. 1280 et seq.) On May 4, 1892, the United States purchased the "Morgan Cut and Canal," 5.43 miles long, from the Buffalo Bayou Ship Channel Company for the sum of $92,316.85. This addition of 5.43 miles to the length of the ship channel made necessary a further revision in the estimated cost of the improvement. The amount was increased to $896,175.44, which, added to the amount paid for the Morgan Cut and Canal, made the total cost $988,492.29. In addition it was estimated that an annual sum of $100,000 would probably be required for maintenance after completion of the channel. (See Annual Report of the Chief of Engineers for 1892, p. 1536 et seq.)

The amount expended up to the close of the fiscal year ending June 30, 1896, was $798,836.85.

At that time a channel having a least depth of 8½ feet and width of 100 feet was available from Bolivar Channel to the Morgan Canal.

No work was done during the fiscal year, owing to the fact that the depth of water in the ship channel was greater than that found in Buffalo Bayou immediately at and below Houston, and was all that was demanded by the draft of vessels navigating this channel, Congress having also indicated, in an act approved February 1, 1897 (Public No. 38), a possible intention of again amending the project so as to obtain a least depth of 25 feet in the ship channel.

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A gradual shoaling takes place along this channel when work is suspended. A survey made in March, 1897, gave a least depth of 8 feet along the channel line.

The sum of $1,491.31 was expended during the present fiscal year, principally in making the survey called for by above-mentioned act.

The largest part of the commerce of Buffalo Bayou and Trinity River is carried through the ship channel to the deep water at Galveston. Detailed statements giving character and amounts will be found in the respective reports on those streams.

July 1, 1896, balance unexpended	$50,180.00
June 30, 1897, amount expended during fiscal year	1,491.31
July 1, 1897, balance unexpended	48,688.69

Amount (estimated) required for completion of existing project	169,675.44
Amount that can be profitably expended in fiscal year ending June 30, 1899	169,675.44
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix T 2.)

3. Channel in West Galveston Bay, Texas.—West Galveston Bay is a body of water covering about 39 square miles, and lies between Galveston Island and the mainland. It extends from Galveston Bay to the west end of Oyster Bay, and is connected with the Gulf of Mexico by San Luis Pass, at the western extremity of Galveston Island, and with the Brazos River by the Galveston and Brazos Canal. The natural depth of the bay was from 2½ to 3 feet.

The project for improving the bay was adopted on June 13, 1892, and consisted in widening, deepening, and straightening the channel so as to give a width of 200 feet and a least depth of 3½ feet from Galveston Bay to San Luis Pass and a channel 100 feet wide and 3 feet deep along Christmas Point in Oyster Bay, both channels to be properly defined by beacons. The estimated cost of the improvement was $28,998.80. (See Annual Report of the Chief of Engineers for 1892, p. 1556 et seq.) On July 8, 1896, authority was given to modify the project so as to afford a depth of 5 feet instead of 3½ feet, provided the cost of the work was not increased.

The amount expended to June 30, 1896, was $19,750.97.

This expenditure resulted in an unobstructed channel 100 feet wide and from 3 to 3½ feet deep from Galveston Bay to the Galveston and Brazos Canal. Beacons were also erected to define the channel.

No work was done during the fiscal year, for the reason that a greater depth of water existed in the bay than was found in the Galveston and Brazos Canal, which is owned by a private corporation having the right to charge tolls, and through which all vessels plying between Galveston and the Brazos River usually pass.

The amount of freight carried through the bay during the year was 11,100 tons, of which 3,000 tons was cotton and 8,100 tons was general merchandise.

July 1, 1896, balance unexpended	$5,249.03
July 1, 1897, balance unexpended	5,249.03

Amount (estimated) required for completion of existing project	4,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	4,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix T 3.)

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4. Trinity River, Texas.—The improvement of this stream has been limited to that portion lying between the mouth and Liberty, at the head of tide water, a distance of 39 miles. The river empties into Galveston Bay through several mouths or passes, opposite each of which a bar existed, on which the depth of water did not exceed 3¼ feet at mean low tide.

The project adopted for this improvement on June 18, 1878, consisted in the removal of snags from the river below Liberty and in dredging a channel 80 feet wide by 6 feet deep across the bar at the mouth of the pass then in use by vessels. The estimated cost of the work was $22,581.40. (See Annual Report of the Chief of Engineers for 1873, p. 685 et seq.) On May 4, 1889, an amended project was adopted. It contemplated the erection of two parallel jetties at the mouth known as the Middle Pass, placed about 275 feet apart and extending about 7,750 feet into Galveston Bay, also in closing the other two principal passes by submerged dams, the object being to create and maintain a channel 6 feet deep at mean low tide at the mouth of the river. The revised cost of the improvement was placed at $89,500. (See Annual Report of the Chief of Engineers for 1889, p. 1557 et seq.)

The amount expended on this improvement to the close of the fiscal year ending June 30, 1896, was $69,179.76.

At that date the west jetty had been completed, its length being 7,359 feet, and a channel 100 feet wide by 5 feet deep had been secured at the mouth of the river.

No work was done during the fiscal year, for the reason that there was sufficient depth of water on the bar at the mouth to accommodate all vessels navigating the river, and because by a retention of the available funds until a sufficient amount had accumulated to complete the work the east jetty could be more economically constructed.

The amount ($150) expended during the year was applied to procuring a record of the commerce using the mouth of the river.

The total amount of freight carried during the fiscal year between Wallisville and the mouth was 6,828 tons, of which 92 tons was cotton, 5,795 tons was lumber, 718 tons was coal, 37 tons was stock, and 186 tons was general merchandise.

July 1, 1896, balance unexpended	$7,820.24
June 30, 1897, amount expended during fiscal year	150.00
July 1, 1897, balance unexpended	7,670.24
Amount (estimated) required for completion of existing project	15,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	15,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix T 4.)

5. Buffalo Bayou, Texas.—This is a tide-water stream emptying into the San Jacinto River at Lynchburg, about 25 miles below Houston. It is one link in the waterway connecting Houston with Galveston and the Gulf of Mexico, the other links being the San Jacinto River and the ship channel in Galveston Bay. In its natural state the bayou, between Houston and Simms Bayou, a distance of 11 miles, was narrow and tortuous and had a depth in many places of not more than 5 feet; the channel was also obstructed by shoals, logs, and overhanging trees; below Simms Bayou it was wide and deep and required but little or no improvement.

On March 3, 1881, a project was adopted for improving this bayou, the object being to straighten the channel, widen it to 100 feet, deepen it to 12 feet, and to remove such snags, logs, and overhanging trees as

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were obstructions to navigation. The cost was estimated at $385,299.75. (See Annual Report of the Chief of Engineers for 1881, p. 1344 et seq.)

The amount expended to June 30, 1896, was $208,318.82.

This expenditure resulted in an unobstructed channel, 10 feet deep and at least 100 feet wide, from Houston to the mouth.

No work was done during the fiscal year, principally owing to the fact that at the beginning of the cotton season there was as great depth of water in the bayou as was demanded by the draft of vessels navigating this channel, and as Congress by act approved February 1, 1897, Public No. 38, had indicated a possible intention of amending the project so as to provide a channel not less than 25 feet deep and 100 feet wide from Houston to Galveston, and a harbor at or near Houston 500 feet wide by 25 feet deep.

A survey of the bayou made in March, 1897, gave a least depth in the channel of 9½ feet, except directly at, and for a short distance below, the city of Houston, where considerable shoaling has occurred, due to surface wash and sewage from the city.

The sum of $1,417.56 was expended during the fiscal year in making survey and collecting the commercial statistics of the bayou.

The total amount of commerce brought down the bayou during the fiscal year amounted to 129,054 tons, an increase of 14,175 tons over last year. Of this, 82,767 tons was cotton, 22,823 tons was cotton products, 1,948 tons was coal, 2,569 tons was lumber, 10,158 tons was building material, and 8,789 tons was general merchandise.

July 1, 1896, balance unexpended	$20,431.18
June 30, 1897, amount expended during fiscal year	1,417.56
July 1, 1897, balance unexpended	19,013.62
Amount (estimated) required for completion of existing project	156,549.75
Amount that can be profitably expended in fiscal year ending June 30, 1899	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix T 5.)

6. Brazos River, Texas.—This improvement is at present limited to that portion of the river lying between Richmond and Velasco, a distance of about 89 miles; its low-water level is affected by the Gulf tide as far up as Bolivar Landing, 40 miles above Velasco. The course of the river is tortuous and the channel was obstructed by shoals and snags.

The project for improvement was adopted June 3, 1896, and consisted in the removal of snags and overhanging trees. It was estimated that $10,000 would put this portion of the river in a good navigable condition at ordinary stages, and that an annual expenditure of $2,500 would keep it in this condition. (See Annual Report of the Chief of Engineers for 1895, p. 1838 et seq.)

No work has been done under this project, owing to the unfavorable stages of water in the river.

The amount of freight carried on this river between Velasco and Richmond was 14,700 tons, divided as follows: Cotton, 3,750 tons; cotton seed, 7,500 tons; cattle, 2,000 tons; lumber, 450 tons; and general merchandise, 1,000 tons.

July 1, 1896, balance unexpended	$5,000.00
July 1, 1897, balance unexpended	5,000.00
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix T 6.)

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7. Operating and care of Morgans Canal, Texas.—The expenses of caring for this canal during the fiscal year ending June 30, 1897, amounted to $375, of which the sum of $240 was paid from the permanent indefinite appropriation provided by section 4, act of July 5, 1884. A statement contained in the report of the local engineer officer shows the items of expenditure of the latter amount.

(See Appendix T 7.)

EXAMINATION AND SURVEY MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The preliminary examination and survey of the following localities, required by the act of June 3, 1896, were made by the local engineer, Maj. A. M. Miller, Corps of Engineers, and reports thereon submitted through the division engineer, Col. J. W. Barlow, Corps of Engineers:

1. Preliminary examination of channel between Brazos River and Galveston Bay, Texas.—Major Miller submitted report of examination November 16, 1896. From this report it appears that there exists a navigable channel 3 feet in depth from Galveston Bay to Brazos River, except through the canal of the Galveston and Brazos Navigation Company, and the local officer states that, in view of the high estimate of value placed upon its franchise by the company, in his opinion that part of the route under examination which consists of this canal is not worthy of improvement by the United States. If these works could be purchased at a reasonable price, the Government would be justified in keeping the route open. The views of the local officer are concurred in by the division engineer and by the Chief of Engineers. The report was transmitted to Congress and printed in House Doc. No. 89, Fifty-fourth Congress, second session. (See also Appendix T 8.)

2. Survey for further determining the causes of the erosion of the easterly end of Galveston Island, Texas, and estimating the cost of works to prevent the same.—Major Miller submitted report of survey November 16, 1896. Comparing the results of this survey with survey made in 1894, he states that the effect of the extension since 1894 of 3,000 feet of the south jetty at Galveston has almost if not quite caused a cessation of erosion at the eastern end of the island, and that it is almost certain no further erosion at that point need be apprehended. From this he considers an estimate of the cost of works to prevent further erosion unnecessary, it being evident that the south jetty affords sufficient protection. The views of the local officer are concurred in by the division engineer and by the Chief of Engineers. The report was transmitted to Congress and printed in House Doc. No. 116, Fifty-fourth Congress, second session. (See also Appendix T 9.)

REPORT OF BOARD OF ENGINEERS AUTHORIZED BY RIVER AND HARBOR ACT OF JUNE 3, 1896.

The act of June 3, 1896, made provision for a Board of Engineers, to be appointed by the President, *for the purpose of ascertaining the character and value of the improvements made at the mouth of the Brazos River, Texas, by the Brazos River Channel and Dock Company.* The Board, which consisted of Col. Henry M. Robert, Corps of Engineers, Mr. Stehman Forney, Assistant, United States Coast and Geodetic Survey, and Mr. Robert Moore, C. E., submitted its report upon the subject under date of February 18, 1897. The report was transmitted to Congress and printed in Senate Doc. No. 138, Fifty-fourth Congress, second session. (See also Appendix T 10.)

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WESTERN RIVERS.

IMPROVEMENT OF CERTAIN RIVERS AND WATERWAYS IN LOUISIANA, TEXAS, ARKANSAS, AND MISSISSIPPI, TRIBUTARY TO MISSISSIPPI RIVER; WATER GAUGES ON MISSISSIPPI RIVER AND PRINCIPAL TRIBUTARIES.

This district was in the charge of Maj. J. H. Willard, Corps of Engineers. Division Engineers, Col. J. W. Barlow, Corps of Engineers, to May 7, 1897, and Col. Henry M. Robert, Corps of Engineers, since that date.

1. *Red River, Louisiana and Arkansas.*—This improvement was begun in 1828 and appropriations aggregating $535,765.50 were made between 1828 and 1852. Between 1841 and 1852 no appropriation was made, and a longer interval elapsed between 1852 and 1872, during which the results of former work were lost.

The present improvement commenced in 1872. At that time the river above Shreveport, La., was closed by the great raft, 32 miles long and increasing with each flood; below Shreveport the river was affected seriously by the gradual enlargement of Tones Bayou outlet, which depleted the main channel and threatened its closure to navigation; the falls at Alexandria were impassable at low stages; snags, stumps, sunken logs, and leaning timber rendered navigation difficult and dangerous the entire length of the river, and more than a hundred steamboat wrecks lay in the channel between Fulton, Ark., and the mouth.

The project adopted in 1872 contemplated removing the raft and closing Tones Bayou. It has been amplified since to include the removal of jams, snags, wrecks, leaning timber, etc.; opening and enlarging the channel through the falls at Alexandria, deepening shoal places, closing outlets, fixing caving banks, and building and repairing levees; to improve and keep navigation open from the head of Atchafalaya River, Louisiana, to Fulton, Ark., 508.6 miles. The nature of the work requires that it be continued for many years, and no estimate for completion is given on this account.

Under the provisions of the river and harbor acts of 1892 and 1894 the work on this river is carried on in accordance with plan of Major Willard, and of the estimate submitted by him for the fiscal year ending June 30, 1899, a little more than 78 per cent is for the construction of levees which form a part of Major Willard's plans.

The amount expended under this project to June 30, 1896, was $1,287,002.14, with the following results: In the old raft region there flowed in the course marked out for it a broad and deep river, safe at all but the lowest stages, with a channel constantly scouring, the bottom having gone down as much as 15 feet, and the low-water line following it to a certain extent. In addition to opening hundreds of miles of navigable waterway, the removal of the raft drained the great valley of the river and reclaimed thousands of acres of productive lands. Tones Bayou outlet was closing gradually, and the main channel below had widened and scoured until it carried the greater portion of the discharge at flood, and navigation of the stretch formerly impaired by the outlet was uninterrupted at the lowest stages. The falls at Alexandria had been made passable the year round, an increase of about two months in the period of navigation. Persistent snagging operations, repeated from time to time, kept the river open, prevented formation of raft, reduced the dangers of navigation to a minimum, and enabled steamboats to make regular trips. At very low stages, say barely a foot above zero on the Shreveport gauge, the river was open to boats of 3 feet draft from the Atchafalaya to Fulton.

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In the fiscal year ending June 30, 1897, snagging operations extended over the river from Fulton to the Atchafalaya, and were carried into Sulphur River, a tributary of the Upper Red, in accordance with the act of 1894. Heavy work was done and immense quantities of obstructions were removed from the bed and banks of the river. During the period of lowest water three snag boats and a shore party were employed. Dredging to straighten the cut through the upper falls at Alexandria, La., and make passage easier, was resumed the latter part of October and continued until high water in January; 4,951 cubic yards of rock was excavated from the channel, with benefit to low-water navigation. No levee work was undertaken by the United States, but the State of Louisiana built 5.31 miles of new line and 15.23 miles of enlargement, containing 536,988 cubic yards, at a cost of $47,820.77.

The amounts expended during the year and balances July 1, 1897, are as follows:

Allotments.	Expended during year.	Balances July 1, 1897.
For general improvement, repairs, care of plant, etc	$29,692.15	$20,404.94
For Little River from Scopini Cut-off to Knox Point (act September 19, 1890)	1,116.65	10,000.72
For work at Alexandria, La	6,129.38	3,574.25
For construction of levees	54.50	63,382.69
For Sulphur River	981.57	2,661.01
Total	37,974.25	100,023.61

It is recommended that legislative action be taken to transfer the balance of allotment for Little River to the allotment for general improvement. The stretch between Scopini Cut-off and Knox Point, 17½ miles long, called Little River, can be kept in good navigable condition by following the adopted plan of occasional work in connection with the general improvement, or work at any special point when required for the immediate needs of commerce, but as the act of September 19, 1890, directed that the funds should be used in deepening and widening Little River, the transfer can not be made until authorized by Congress.

July 1, 1896, balance unexpended	$137,997.86
June 30, 1897, amount expended during fiscal year	37,974.25
July 1, 1897, balance unexpended	100,023.61
July 1, 1897, outstanding liabilities	54.37
July 1, 1897, balance available	99,969.24
Amount that can be profitably expended in fiscal year ending June 30, 1899 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	700,000.00

(See Appendix U 1.)

2. Red River, above Fulton, Ark.—Before work commenced, this part of Red River was obstructed by snags and piles of drift, rendering navigation difficult and hazardous at all stages. The project adopted in 1886 contemplated removal of these obstructions to afford reasonably safe navigation at high stages of river to the mouth of Kiamichi River, Indian Territory, about 138 miles above Fulton.

The amount expended to June 30, 1896, was $18,059.56. The project of 1886 was completed in 1891 at a cost of $11,774.89, and at the close of that year it was recommended that no further work be done, unless a single appropriation of $10,000 should be granted to allow the systematic clearing of the banks and channel without interruption. The two

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succeeding river and harbor acts appropriated $3,500 each for continuing the improvement, which was applied to maintenance of the work.

No work was done during the fiscal year ending June 30, 1897.

The commerce of this part of Red River is insignificant at the present time, and the work done has had no perceptible effect upon it. It consists chiefly of logging, with occasional shipments of cotton, seed, and plantation supplies when boats run above Fulton.

The officer in charge has been authorized to include estimates for this work under the heading of improving Red River, Louisiana and Arkansas, and to continue operations under the act of June 3, 1896, with one of the snag boats belonging to that work, as they can be carried on with greatest economy and advantage in conjunction with the main work below Fulton to the Atchafalaya.

July 1, 1896, balance unexpended	$3,940.44
July 1, 1897, balance unexpended	3,940.44

(See Appendix U 2.)

3. Cypress Bayou, Texas and Louisiana.—Cypress Bayou evidently was an unnavigable stream until the advance of the Red River raft above Shreveport had converted its bottom lands into reservoirs known as Fairy, Sodo, and Cross lakes. Before the work for its improvement between Shreveport, La., and Jefferson, Tex., commenced navigation was difficult and dangerous by reason of bars and leaning timber in the bayou proper, and snags, stumps, fallen timber, and sunken logs in the channel through the lakes.

The project adopted in 1872 contemplated straightening the channel and dredging bars in Cypress Bayou, to give uniform depth, and the removal of overhanging trees, shore snags, etc., opening and enlarging the entrance of the bayou into the head of Fairy Lake by dredging, removing stumps, snags, sunken logs, and timber from the channel selected down the lakes, and snags, leaning trees, etc., in Twelve Mile Bayou.

The amount expended to June 30, 1896, was $130,514.41. The original project was completed in 1880 at a cost of $94,000, but owing to the temporary nature of the work it had to be renewed at intervals to maintain what had been accomplished. The last work for the removal of stumps, snags, and leaning timber was done in 1893. No dredging has been done since 1888. The removal of the Red River raft and the closure of outlets along the right bank of that stream reduced the water supply and caused the lakes to drain more rapidly, shortening the period of navigation. To determine if navigation could be permanently improved by locks or dams, an extended survey was ordered by Congress, which was completed in 1893 at a cost of $12,000.

The act of August 18, 1894, provided $10,000 for maintenance of the work by dredging, removing obstructions, and straightening the channel, and the act of June 3, 1896, appropriated $5,000 for continuing improvement.

The work done since 1886 has had no permanent effect upon the commerce between Jefferson and Shreveport, which has dwindled to insignificance. The maintenance of the water route doubtless will act more as a check upon freight rates than as a means of transportation.

July 1, 1896, balance unexpended	$15,186.92
June 30, 1897, amount expended during fiscal year	619.17
July 1, 1897, balance unexpended	14,567.75
July 1, 1897, outstanding liabilities	7.80
July 1, 1897, balance available	14,559.95

(See Appendix U 3.)

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4. Ouachita and Black rivers, Arkansas and Louisiana.—The improvement of Ouachita River commenced in 1871. Black River, 47 miles long, connecting Ouachita with Red River, was added under the same head of appropriation by act of 1884. The original project contemplated temporary improvement of the Ouachita from Arkadelphia, Ark., to Trinity, La., by removal of snags, etc., and dredging the worst bars. In 1872 a project for improvement by locks and dams was entered upon, but it was abandoned in 1874 for various reasons, the chief one being that the locks would be idle at the time intended for use until a permanent improvement should be obtained at mouth of Red River. The project under which work has continued since 1874 contemplates the removal of snags, logs, wrecks, leaning timber, etc., below Camden, Ark., 341 miles above the mouth of Black River, and the improvement of shoal places by dams and dredging. No estimate of cost is given, as the nature of the work requires that it be continuous.

The total amount expended to June 30, 1896, was $426,145.27. The amount expended under the project of 1874 was $294,730.75. The iron-hull snag boat *Wagner* was purchased for the work in 1875, and the small wooden snag boat *Columbia* in 1888. Operations were carried on whenever funds were available and conditions favorable, and consisted chiefly in removing snags, logs, wrecks, and tree slides in the channel and leaning timber along the banks; an increased depth was gained at some shoals in the upper river by wing dams of stone and brush, the temporary effect of which, however, has been lost. Catahoula Shoals, a rock and gravel bar 20 miles above Trinity, formerly much complained of by steamboat men, were improved permanently by dredging, etc., finished in 1895. To comply with requirement of the act of 1894, a survey was commenced for the purpose of preparing plans and estimates for improvement by locks and dams.

In the fiscal year ending June 30, 1897, the snag boat *Wagner* worked over Black and Ouachita rivers below Monroe, La., a party equipped with tools and explosives worked over 46 miles of the upper river during the period of low water, and the snag boat *Columbia* made a patrol between Camden and Trinity in June. Field work of the survey was carried from Sinope Landing to mouth of Black River, Louisiana, and the gap above Champagnolle to Camden, Ark., was closed in May and June.

The amounts expended during the year and balances July 1, 1897, are as follows:

Allotments.	Expended during year.	Balances July 1, 1897.
For general improvement	$8,851.07	$11,159.31
For survey	20,690.71	35,653.64
Total	29,541.78	46,812.95

July 1, 1896, balance unexpended	$76,354.73
June 30, 1897, amount expended during fiscal year	29,541.78
July 1, 1897, balance unexpended	46,812.95
July 1, 1897, outstanding liabilities	57.64
July 1, 1897, balance available	46,755.31
Amount that can be profitably expended in fiscal year ending June 30, 1899 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	120,000.00

(See Appendix U 4.)

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5. Bayou Bartholomew, Louisiana and Arkansas.—Before this improvement was commenced by the United States the bayou was so obstructed by snags, logs, wrecks, leaning timber, etc., that it was navigable for light-draft boats at high stages only, or for about three months in the year, and even during that short period the passage was slow, difficult, and dangerous.

The project entered upon in 1881 contemplated removing these obstructions to give safe navigation and extend the period thereof. The estimated cost of two seasons' work between Baxter, Ark., and the mouth, about 150 miles, was $26,862, but the appropriations did not permit the thorough work contemplated. If funds had been provided, the work probably could have been completed as planned, but the addition of new obstructions each year would have necessitated small appropriations for maintenance.

The amount expended in the fourteen years ending June 30, 1896, was $41,413.35, resulting in safer navigation, increasing the period to about six months of the year, enabling boats of double the capacity of those formerly used to make trips in half the time, and reducing freight rates about one-half.

In the past fiscal year thorough work, begun in May, 1896, at McComb Landing, Ark., was continued from near Parkdale, Ark., down to the mouth, and it is proposed to use the available balance in sending a snag boat over the stream at a favorable stage to remove the drift, etc.

This work practically completes the project for removing obstructions between the mouth and McComb Landing, the present head of navigation. To continue operations above that place to Baxter probably will cost about $10,000, but there is no demand for navigation in this upper stretch at present. The estimated cost of maintenance is $2,500.

July 1, 1896, balance unexpended	$5,586.65
June 30, 1897, amount expended during fiscal year	4,460.18
July 1, 1897, balance unexpended	1,126.47
Amount that can be profitably expended in fiscal year ending June 30, 1899, for maintenance	2,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix U 5.)

6. Bœuf River, Louisiana.—The improvement of this stream was undertaken by the State of Louisiana more than half a century ago. Before work commenced by the United States it was navigable to Point Jefferson, La., at high water, but passage was difficult and dangerous on account of overhanging timber, snags, and logs.

The project adopted in 1881 contemplated removing obstructions to afford safe navigation at high stages from the mouth to Wallace Landing, about 152 miles above. The closure of three outlets near Point Jefferson to confine the flow to the main channel was added to the project in 1886.

The amount expended to June 30, 1896, was $46,434.62, which put the stream in safe navigable condition at stages high enough to permit boats to cross the bars and enabled them to save at least thirty-six hours on the round trip.

During the year ending June 30, 1896, thorough work, begun the preceding year at Wallace Landing, was carried down to the mouth, and a snag boat worked from the mouth to within 4 miles of Wallace Landing, removing floating débris, breaking up jams of drift, etc.

This work put the river in good condition and completed the project for benefiting high-water navigation, but will not be permanent, on

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account of obstructions added by drifts, floods, sliding banks, and the rapid growth of timber along the banks. About $2,500 a year will be needed to keep the channel clear of obstructions.

The three outlets near Point Jefferson were closed as securely as possible with the funds available in 1887–88, and their closure gave immediate benefit to navigation by confining the flow to its natural course and scouring the bars below. The dams were destroyed during the overflow from the Mississippi River in 1890, caused by breaks in the Arkansas levees near the head waters of Bœuf River, and funds have not been provided for their restoration. Recent soundings show a very considerable shoaling below the outlets. The estimated cost of the work required for closing them substantially is $30,000. It will be unwise to commence work until all three outlets can be closed without delay, and for this reason a project for expenditure of the appropriation of $6,000 by act of June 3, 1896, has been held in abeyance.

June 15–21, 1897, a snag boat was employed in the lower 100 miles of this river, removing obstructions brought in since work was suspended in March, 1896, but was unable to go higher up on the stage of water.

July 1, 1896, balance unexpended	$8,565.38
June 30, 1897, amount expended during fiscal year	236.92
July 1, 1897, balance unexpended	8,328.46
Amount (estimated) required for completion of existing project	24,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899, for closing outlets	24,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899, for maintenance	2,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix U 6.)

7. Tensas River and Bayou Maçon, Louisiana.—These streams were navigable at high stages before work was undertaken by the United States, but passage of steamboats was difficult and dangerous on account of leaning timber, and snags, logs, etc., in the channel. The project for improving Tensas River, adopted in 1881, contemplated removing obstructions between the mouth and Dallas, about 134 miles above, at an estimated cost of $23,000. Bayou Maçon, the principal commercial branch, was added under the same head of appropriation by act of 1884, and the project contemplated the same class of work between its junction with Tensas River and Floyd, about 98 miles above, at an estimated cost of $17,000.

The amount expended to June 30, 1896, was $30,853.70, of which sum $10,623.50 was applied to Tensas River and $20,230.20 to Bayou Maçon. With these expenditures Bayou Maçon to Floyd and Tensas River to Westwood Place, about 75 miles above its mouth, were put in fairly good navigable condition at medium and high stages for the time.

For lack of plant no work was done during the fiscal year ending June 30, 1897, except a patrol of a snag boat, June 22–25, from mouth of Tensas River to Crockett Landing on Bayou Maçon, a distance of about 100 miles.

The original plans contemplated an expenditure of $40,000 for thorough work in one low-water season. With the small appropriations made at intervals, operations have dragged along over a period of sixteen years, are by no means complete, and new obstructions are added each year.

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July 1, 1896, balance unexpended	$5,146.30
June 30, 1897, amount expended during fiscal year	165.48
July 1, 1897, balance unexpended	4,980.82
Amount (estimated) required for completion of existing project	4,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	4,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix U 7.)

8. Yazoo River, Mississippi.—Prior to improvement, navigation of this river was obstructed by wrecks of gunboats, steamers, etc., sunk to prevent passage during the war of the rebellion, and by a great number of snags, stumps, tree slides, and sunken logs in the channel, and a heavy growth of leaning timber along the banks.

Nine wrecks were removed by contract in 1873–74, and the latter year a project was made to clear the river thoroughly of obstructions then existing in a period of four years, at a cost of $120,000, annual appropriations to be made thereafter for maintenance of the work. The appropriations made were not sufficient to carry out this plan, and work has continued from time to time under a project for the removal of wrecks, snags, logs, leaning timber, etc., so far as the funds provided will permit. Floods, sliding and caving banks, leaning timber, and the rapid growth of vegetation along an alluvial stream of this character add new obstructions to navigation continually, and snagging operations, etc., should continue from year to year in the interest of safe and uninterrupted navigation.

The amount expended to June 30, 1896, was $240,440.13. The results of the work were marked. The large number of wrecks that blocked the channel at low stages and limited the period of navigation had been removed so as to present no obstruction, and the removal of snags, logs, leaning timber, etc., repeated from time to time, opened and maintained steamboat navigation from mouth to head of the river the year round.

In the fiscal year ending June 30, 1897, operations continued as follows: During the period of lowest water, September 25 to December 5, 1896, the stretch from head of river downstream about 60 miles was worked over for the removal of snags, logs, stumps, caved-in trees, etc., in the channel, and the heavy growth of timber and brush along the banks. Effective work was done, and a great number of obstructions were removed and destroyed. High stages of river, prolonged by the great flood of Mississippi River, prevented further advantageous work until June, 1897, when the snag boat belonging to this improvement was needed temporarily to tow a dredge into Red River. It was the intention to resume operations with this vessel as soon as it returned to Vicksburg.

Work in Yazoo River and its tributaries could be carried on with greatest economy and the best results obtained if the streams were grouped as a system under one general head, and with this view the appended estimate is made. If sufficient plant is acquired, and the work thoroughly done, the cost of maintenance should decrease each year.

The river and harbor act of August 11, 1888, contained an appropriation of $32,000 for improving Yazoo River, and provided that of this sum $8,000 shall be used for constructing a pumping dredge boat. An unexpended balance of $2,036.14 of this allotment for constructing the pumping dredge remains unexpended and is not required for the purpose named in the act, and it is recommended that the assent of Con-

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gress be given for the transfer of this balance to the allotment for general improvement of the river.

The acts of August 18, 1894, and June 3, 1896, each provides, in the item of appropriation for Yazoo River, for application of a portion of the funds provided to removing bar at Yazoo City. This provision was not inserted in the acts upon recommendation of this office, and there appears to be no sufficient reason why the bar mentioned should be removed. In fact, the officer in charge states that the survey made in June, 1896, confirms his opinion that removal of the bar at Yazoo City would impair the navigation of the river at and above the bar. For the above reasons, and for the further reason stated by Major Willard that the sentiment of such citizens as expressed themselves on the subject was decidedly adverse to the removal of the bar on the city front, I recommend that the provisions of the acts of 1894 and 1896, touching removal of this bar, be repealed.

July 1, 1896, balance unexpended	$34,559.87
June 30, 1897, amount expended during fiscal year	6,923.00
July 1, 1897, balance unexpended	27,636.87
Amount that can be profitably expended in fiscal year ending June 30, 1899	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix U 8.)

9. Mouth of Yazoo River and harbor at Vicksburg, Miss.—The shifting bar at mouth of Yazoo River is the most serious obstruction to navigation of that river and its tributaries, a system of about 800 miles of navigable waterways. At low stages steamboats are prevented from entering or leaving the river without lightering, and frequently navigation across the bar is closed entirely at the busiest season of the year. A survey with a view to giving free passage the year round for vessels engaged in navigation of the river was directed by river and harbor act of 1890, and the plan based thereon contemplated making a new mouth or outlet for the river from the former mouth of Yazoo, on Old River, about 9.8 miles above present mouth, through the deep water in Old River, across the neck of low land between Long and Barnett lakes to Lake Centennial, and thence down Lake Centennial, around the head of De Soto Island and along the front of Vicksburg, entering Mississippi River on the channel side at Kleinston Landing. Vicksburg Harbor is that part of the old channel of the Mississippi cut off in 1876 and now known as Lake Centennial, in front of the city and extending down to Kleinston.

The original estimate of cost of the work required was $1,500,000, but was revised in 1893 and reduced to $1,200,000, upon a basis of completion in three years. The project was entered upon by the United States in the river and harbor act of 1892, which provided $75,000 for beginning work, and the act of 1894 contained appropriations of $265,000 for continuing the improvement. The sundry civil act of June 4, 1897, appropriated $350,000 for the work, making the total sum appropriated $690,000.

The river and harbor act of June 3, 1896, appropriated no money, but provided for completing the work, as follows:

Improving mouth of Yazoo River and harbor of Vicksburg, Mississippi. For the purpose of completing the project of improvement as heretofore adopted and entered upon, in addition to expending the balance on hand, contracts may be entered into by the Secretary of War for such materials and work as may be necessary to complete the same, or said materials may be purchased and work may be done otherwise than by contract to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate eight hundred and sixty thousand dollars, exclusive of the amount heretofore appropriated.

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The amount expended to June 30, 1896, was $132,434.95. The preliminary surveys and maps were finished. A final line had been selected for the excavation between Old River and Lake Centennial, borings had been made, and character of material determined. Property lines were traced on the ground, and the limits of right of way to be acquired ascertained and marked. Abstracts of title were prepared from the county records, and the Attorney-General having given opinions that titles were valid, definite offers were obtained from the various owners and the purchases made under authority of the Secretary of War, aggregating 1,155.54 acres, which cost $34,254.68, or an average price of $29.64 per acre. Jurisdiction over these lands was ceded the United States by the State of Mississippi. A base for future levels along the whole route from Old River to Kleinston was measured with steel tape, and reference points, marked with vitrified pipes filled with cement, were set every 164 feet. Between Old River and Lake Centennial the pipes were set along both sides of the route 328 feet from the center line. The entire route from Old River to Kleinston was cleared and grubbed. A considerable amount of the timber felled was cribbed and towed into Lake Centennial, to be sunk as a foundation for the dam across the west arm. All logs, stumps, and débris that could not be towed off the right of way were piled and burned. A ditch was cut to drain Barnett Lake, which lowered the surface sufficiently to remove stumps in the lake bed. It having been considered advisable to remove by scrapers a part of the land cut near both ends, where the ground was highest, so that dredges could operate over the elevated portions at high stages, withdrawing to lower lands as the water fell, and also to permit towing logs from the right of way, 116,528 cubic yards of earth was removed by contract, and the material placed in continuous embankments along both sides of the route.

In the fiscal year ending June 30, 1897, a second contract of the same nature was let, and 161,181 cubic yards of earth was removed and the material used in extending the embankments.

The condition of the work at end of the year is summarized as follows:

Work done:		
Surveys and mapping.		
Reference signs erected		317
Land purchased	acres	1,156.54
Timber land cleared	do	166.20
Timber land grubbed	do	183.47
Right of way freed of logs and stumps, removed and destroyed	do	98.84
Excavation	cubic yards	277,709
Drains and ditches	do	6,756
Approximate work to be done:		
Excavation	cubic yards	5,608,290
Levees	do	65,000
Dam across west arm of Lake Centennial	do	3,008,400

July 1, 1896, balance unexpended	$207,565.05
Amount appropriated by sundry civil act approved June 4, 1897	350,000.00
	557,565.05
June 30, 1897, amount expended during fiscal year	33,413.70
July 1, 1897, balance unexpended	524,151.35
July 1, 1897, outstanding liabilities	22.83
July 1, 1897, balance available	524,128.52
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	510,000.00

(See Appendix U 9.)

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10. Tallahatchie River, Mississippi.—Before this work was undertaken the river was navigable to Sharkey, about 65 miles above the mouth, for six months of the year, but passage for steamboats was difficult and dangerous. Above Sharkey a heavy growth of leaning timber rendered navigation dangerous and the stream nearly impassable at all stages. The project contemplated removing the wreck of the ocean steamship *Star of the West*, sunk during the war of the rebellion 8 miles above the mouth, and snags, sunken logs, leaning timber, etc., to give ease and safety to navigation from head of Yazoo River to mouth of the Coldwater, about 100 miles above, and it was proposed to do the work required in two seasons, at a cost of $40,000.

The first appropriation was made by act of March 3, 1879, and the amount expended to June 30, 1896, below mouth of Coldwater was $46,485.84. The appropriations for the seventeen years amounted to $50,500. The acts of 1880, 1881, and 1882 required $10,000 to be applied to the stretch of river above mouth of Coldwater to Batesville, known as the Little Tallahatchie, which resulted in no benefit to navigation.

The intermittent work, however, benefited navigation considerably, enabling steamboats to run to Sharkey the year round and to mouth of Coldwater River at high stages. In the fiscal year 1896 leaning timber and obstructions in the channel between Sharkey and Coldwater River were removed as far as practicable with the funds available, and the work enabled small boats to run that stretch with safety at much lower stages than formerly.

During the fiscal year ending June 30, 1897, operations for the removal of obstructions in the channel and along the banks were continued from a point 2 miles below Sharkey to the mouth. This work was done at the lowest stages, a great number of snags, stumps, logs, trees, etc., were removed and destroyed, and the lower river was put in good navigable condition for the time.

New obstructions are brought into the river every year by drift and sliding and caving banks, and the shifting and scouring of the channel exposes snags and logs, embedded in the bottom, from time to time or lodges them upon bars. An appropriation sufficient to permit the systematic clearing of the banks, in addition to snagging operations, could be expended profitably in one season of low water, would result in lasting benefit to navigation, and but small amounts would be needed for maintenance.

July 1, 1896, balance unexpended	$4,014.16
June 30, 1897, amount expended during fiscal year	3,489.52
July 1, 1897, balance unexpended	524.64
Amount that can be profitably expended in fiscal year ending June 30, 1899	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix U 10.)

11. Big Sunflower River, Mississippi.—Before the improvement of this river commenced navigation was badly obstructed by snags, sunken logs, leaning timber, sand bars, and shoals. The low-water channel at many places was so filled with logs as to give no greater depth than 18 inches and so narrow as to afford passage for the smallest boats only. Leaning timber obstructed navigation at all stages, and Oliphant Bar, extending from the mouth upstream 15 miles, and Muscle Shoals, 5 miles long, beginning about 30 miles above the mouth, had depths at low water ranging from 17 to 24 inches.

The project entered upon in 1879 contemplated work during three to

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four consecutive seasons of low water for the removal of leaning timber and obstructions in the channel and the building of wing dams to scour a depth of about 40 inches at the bars, at a probable cost of $66,000, operations to extend to Clarksdale, about 180 miles above the mouth. In the first three years, 1879–1882, $37,000 was appropriated, and fairly good progress was made. In the succeeding fourteen years only $30,000 was provided for continuing the improvement; new obstructions were adding continually and prevented further advancement.

The amount expended to June 30, 1896, was $67,000. Before work commenced there was navigation for light boats about six months of the year. The work done enabled boats to run to Woodburn, 77 miles above the mouth, the year round, and at ordinary stages to make the trip in little more than half the time formerly required. Passage was difficult and dangerous at low stages. Faisonia, about 100 miles above the mouth, was considered the head of navigation. Freight rates were said to have been reduced 50 per cent.

No work was done during the fiscal year ending June 30, 1897, for lack of plant. The amount available was too small to construct or hire and fit out a suitable vessel, and operations were deferred until plant could be spared from other portions of the district.

As new obstructions are added from time to time, it is impracticable to make a definite estimate for completing the project, but an expenditure of $20,000 in one or two low-water seasons will result in greater benefit to navigation and in work of a more lasting character than in the past.

July 1, 1896, balance unexpended	$5,000.00
July 1, 1897, balance unexpended	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	20,000.00

(See Appendix U 11.)

12. Water gauges on the Mississippi River and its principal tributaries.—These gauges were designed to secure information from continuous records, with a view to protecting alluvial lands against overflow, improving navigation, and giving correct reports of the stages of water for the benefit of river men and planters. Their establishment and the maintenance of daily observations were enjoined upon the Secretary of War by joint resolution of Congress approved February 21, 1871 (Stat. L., vol. 16, p. 598). Section 6 of the river and harbor act of 1888 provided a permanent indefinite appropriation for the purpose of securing uninterrupted gauging.

The amount expended to June 30, 1896, was $114,087.88. The 17 gauges ordered by the resolution of February, 1871, were established the latter part of that year, except the one at Carrollton, La., established in January, 1872. Seven additional gauges have been established and 2 discontinued, and there are now 22 gauges maintained. The service has been improved materially. In 1881 bulletins were erected at the stations on the Mississippi for the purpose of giving passing steamboats the stage of water, and to indicate whether rising, stationary, or falling. In 1890 they were replaced by larger bulletins and the old ones used for extending the service to the tributaries. Since February 1, 1887, the gauges have been read and bulletins posted twice a day. The readings have been published by the Mississippi River Commission to end of the calendar year 1896.

The yearly expenses of this work, if properly maintained, vary con-

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siderably, and extraordinary repairs of the gauges and bulletins, frequent inspections, etc., may increase the cost for one year to double that of the year preceding or following it. At the present time a large number of the gauges need extensive repairs, and the bulletins on the Mississippi, built in 1890, are worn out and should be replaced by a more permanent type. Four new gauges were added in 1890, increasing the cost of observations alone by the sum of $540 per annum, with additional charges for inspections and repairs.

Under existing decisions, a fiscal year appropriation of not to exceed $6,000 is provided, of which $500 is allotted under the law for discharge measurements at St. Paul, Minn., leaving but $5,500 for this work. The amount is not sufficient for proper maintenance of the present service.

July 1, 1896, amount available	[1]$5,500.00
June 30, 1897, amount expended during fiscal year	5,000.00
July 1, 1897, amount reverting to the Treasury	500.00
Amount available for fiscal year ending June 30, 1898	5,500.00

(See Appendix U 12.)

EXAMINATION MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The preliminary examination of *Coldwater River, Mississippi*, required by the act of June 3, 1896, was made by the local engineer, Maj. J. H. Willard, Corps of Engineers, and report thereon submitted August 15, 1896, through the division engineer, Col. J. W. Barlow, Corps of Engineers. It is the opinion of these officers, concurred in by the Chief of Engineers, that this river is at present not worthy of improvement by the United States. The report was transmitted to Congress and printed in House Doc. No. 121, Fifty-fourth Congress, second session. (See also Appendix U 13.)

IMPROVEMENT OF ARKANSAS RIVER AND OF CERTAIN RIVERS IN ARKANSAS AND MISSOURI.

This district was in the charge of Capt. William L. Sibert, Corps of Engineers. Division Engineers, Col. John W. Barlow, Corps of Engineers, to May 7, 1897, and Col. Henry M. Robert, Corps of Engineers, since that date.

1. Removing obstructions in Arkansas River, Arkansas and Kansas.—This river was, previous to improvement, seriously obstructed by snags, overhanging timber, reefs, and bars.

The original project under this head was to raise and destroy snags, cut overhanging timber, remove bowlders and reefs by blasting and dredging, and cut out sand bars by temporary wing dams. To this was later added the survey of the river, with the view to permanent improvement.

Since appropriations for permanent improvement were made, blasting, dredging, and dams have been omitted from the project, leaving customary snagging operations only.

On this work there had been expended to June 30, 1896, $848,597.40.

The evidence of pilots and masters is that in the permanent reaches of the river the condition has been materially improved; in the shifting

[1] The amount available for fiscal year ending June 30, 1897, was given in last report as $5,645.83. Under the Comptroller's designation as a fiscal year appropriation the unexpended balance of $145.83 from the preceding year has been deducted in the foregoing statement.

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channels the relief is only temporary, and the obstructions to navigation are still numerous and dangerous. The best illustration of the condition is the fact that steamboats have to pay 18 per cent per annum for insurance.

Little has been done this fiscal year under this head, the snag boats having been employed under the appropriation for improving Arkansas River, Arkansas. By these operations the river has been materially improved.

The two snag boats, *Wichita* and *Beauregard*, belonging to this appropriation, are in bad repair. A new snag boat, which will cost about $30,000, is needed for this work. The hull of the *Beauregard* is rapidly deteriorating, and should be replaced by a new one, at a probable cost of $8,000.

The commerce of the stream consists of plantation products and supplies, timber and cooper stuffs, and general merchandise. The average tonnage for the last four years is 58,600; that reported for this year is 66,077 tons, the value being estimated at $1,657,218.

Snagging operations on this stream are a continuous necessity and can never be completed as long as there are caving banks and shifting channels.

July 1, 1896, balance unexpended	$20,686.06
June 30, 1897, amount expended during fiscal year	2,613.47
July 1, 1897, balance unexpended	18,072.59
July 1, 1897, outstanding liabilities	900.00
July 1, 1897, balance available	17,172.59
Amount (estimated) required for work annually	35,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	35,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix V 1.)

2. Arkansas River, Arkansas.—Besides obstructions, such as snags, etc., the natural channel was and is shifting and obstructed by sand bars, fed by caving banks, and also by reefs of rocks in the upper reaches.

Prior to 1886 works upon this river were special improvements of detached reaches.

The present project was adopted from the mouth of the river to Little Rock in 1886, and extended from Little Rock to Wichita, Kans., in 1888, and is: To remove rock and gravel reefs by blasting and dredging, to contract the channel by dikes or dams, permeable or solid, of such construction as the local conditions require, and to hold the channel so obtained, by revetment where necessary, from the mouth to Wichita, Kans., the object being to obtain a channel depth of 6 feet from Little Rock to the mouth, and one of 2 feet above Little Rock at low water.

From the appropriations made for the improvement of this river, including those made for special reaches, there had been expended to June 30, 1896, $963,694.29. Of this, $798,194.29 was expended on present project and $6,000 was expended in snagging operations.

The work done to this time had been so scattered that only local improvements had resulted. The amounts appropriated for the different reaches have been so small, in comparison with the amount necessary to accomplish the work proposed, that it has been impracticable to work systematically over a reach of river of sufficient length to be of any great benefit to navigation. The work done, however, will form a part

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of a complete system if no great changes occur before sufficient money is available to carry on work to advantage.

During this year the work for permanent improvement, excepting necessary repairs to and completion of old works, has been confined to the river between Little Rock and Cribbs, 21 miles, with a view of completing one reach of river before beginning work on another. The works and the channel produced have not been subjected to the effects of excessive high waters, but indications are that the increased depth of 16 to 22 inches will be reasonably permanent.

During this year repairs to the dikes at Fort Smith and head of Rectors Island were made; repairs commenced on the upper stone dike (No. 2) at Pinebluff, and the works at Bruce Island completed. In the reach of river between Little Rock and Cribbs, two dikes were built at foot of Fletchers Bend; revetment of Reids Bend and construction of three dikes at the foot of it were begun; one dike (new E) and training wall to Dike F were built at Crystal Hill; revetments at Newtons and Greathouse bends were extended; some dredging done in the shoal below the mouth of Little Maumelle Creek, and repairs to Dike D, near Little Rock, were completed.

The snagging operations below Pine Bluff have been of great benefit to navigation, the river now being in better condition than in many years, and the operations for temporary relief enabled the boats to carry larger cargoes during the fall low water than would have been possible otherwise.

The commerce reported this year is 66,077 tons, value estimated at $1,657,218. The commerce reported is not complete, no report having been made for that centering at Fort Smith. The average of tonnage reported for the last four years is 58,600 tons.

July 1, 1896, balance unexpended		$169,805.71
June 30, 1897, amount expended during fiscal year	$120,196.69	
Less refundments of overpayments	36.37	
		120,160.32
July 1, 1897, balance unexpended		49,645.39
July 1, 1897, outstanding liabilities	7,000.00	
July 1, 1897, amount covered by uncompleted contracts	2,000.00	
		9,000.00
July 1, 1897, balance available		40,645.39

Amount (estimated) required for completion of existing project	Indefinite.
Amount that can be profitably expended in fiscal year ending June 30, 1899	500,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix V 2.)

3. White River, Arkansas.—Before improvement this river was seriously obstructed by snags and overhanging timber for its entire length, and by shoals in the upper part of the stream.

The originally adopted and the present project include the usual snagging operations, blasting and dredging, and the contraction by wing dams.

From appropriations for this river and for separate reaches of it there was expended to June 30, 1896, $331,523.10.

The result of the work above Batesville to that time was that during low water a steamboat of 16 inches draft could with difficulty go to Wild Haws (30 miles) and one of 14 inches to The Rapides (72 miles), but the difficulties were such as prevented any commercial navigation at that stage. Swift water was as much an obstruction as the shoals.

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Locks and dams will remove both obstructions. Below Batesville snagging operations were of much benefit.

The operations this year consist of snagging operations between the mouth and Batesville and the building of a hull for the snag boat *Riverside* (hand propelled). The expenses incurred in the building of the new hull are paid from appropriations for improving Current, Black, and White (Cache allotment) rivers, one-third each. The snagging operations have been of much benefit, markedly so between Batesville and Newport.

The commerce of this stream is made up of shipments of plantation products and supplies, timber in its various forms, and miscellaneous freights. The tonnage reported for the year ending May 31, 1897, is 73,612 tons—practically the same as that reported for the two years preceding. The estimated value of the year's commerce is $2,435,114.

The commerce in Cache River for the year ending May 31, 1897, is 34,640 tons, an increase of 13,892 tons over that for year ending May 31, 1896, and of 22,037 tons over that for year ending May 31, 1895. The estimated value of this year's commerce is $107,760.

July 1, 1896, balance unexpended	$38,476.90
June 30, 1897, amount expended during fiscal year	[1] 10,981.93
July 1, 1897, balance unexpended	[2] 27,494.97
July 1, 1897, outstanding liabilities	650.00
July 1, 1897, balance available	26,844.97
Amount (estimated) required for completion of existing project	14,815.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	14,815.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix V 3.)

4. Black River, Arkansas and Missouri.—Before any improvements were made this river was seriously obstructed by snags, logs, and overhanging timber. In many places it was impassable.

The adopted project is for the usual snagging operations, the closing of chutes by dams, and the construction of wing dams to improve the worst shoals.

From the separate appropriations for this stream there had been expended to June 30, 1896, $90,168.10. This expenditure had made 3-foot navigation practicable the entire year from the mouth to Current River, 146 miles, and had made the river from Current River to Poplar-bluff, Mo., 123 miles, navigable for about ten months each year.

During the fiscal year ending June 30, 1897, the river, while near low-water stage, was thoroughly cleared of obstructions below Current River and above Foot of Big Island, while at medium stage the most troublesome snags between Indian Ford and Foot of Big Island were removed. By these operations the river was again placed in good condition. Snags, drift, and fallen timber accumulate rapidly in this stream, and it is the opinion of the officer in charge that snagging operations can be increased with profit.

Timber, in its various forms, makes up the greater portion of the commerce on this stream. The tonnage reported for the year ending May 31, 1897, is 111,611 tons, practically the same as that of the preceding year; the estimated value of the commerce reported is $1,704,799. Full report was not received of either rafted material or steamboat freights.

[1] Of this, $349.41 expended in removing obstructions in Cache River.
[2] Of this, $3,650.59 to be expended in removing obstructions in Cache River.

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July 1, 1896, balance unexpended	$12,331.90
June 30, 1897, amount expended during fiscal year	7,127.06
July 1, 1897, balance unexpended	5,204.84
July 1, 1897, outstanding liabilities	900.00
July 1, 1897, balance available	4,304.84
Amount (estimated) required for work annually	8,000.00
Amount that can be profitably expended for maintenance in fiscal year ending June 30, 1899	8,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix V 4.)

5. Current River, Arkansas and Missouri.—Between the mouth of Current River and the mouth of the Little Black, 32½ miles, the channel was originally obstructed by snags, logs, and overhanging timber. Above the mouth of Little Black, gravel shoals also interfered with navigation.

The approved project is to remove logs and snags from the channel, to cut and deaden overhanging timber, and to contract the channel at the worst shoals by wing dams.

From the appropriations for the improvement of this river, including the amount expended on present project, there was expended to June 30, 1896, $13,355.69. By this expenditure a good channel for boats of 3½-foot draft had been made to Johnsons Landing, 25 miles, a fair medium-stage channel to Currentview, about 40 miles, and a fair rafting channel to 11 miles above Doniphan, Mo.

During the early part of the fiscal year 1897, the hand snag boat *Riverside* removed 137 snags, cut 209 trees, and destroyed 2 drift piles between the mouth and Johnsons Landing, again placing the river in good condition. Freshets have brought many new obstructions in the channel since the *Riverside* was over the river.

The amount estimated for completion of existing project has been appropriated.

Improvements by snagging operations are temporary, as caving banks are continually adding new obstructions. Two thousand dollars will be required each year to maintain the present channel.

The commerce on this stream is made up of shipments of plantation products and supplies, timber and cooperage stuffs, and miscellaneous freights. Full report has not been received of the amount of material transported this year from either consignees of rafted material or from steamers plying this stream. The average of tonnage for the two years preceding June 1, 1896, is 30,536 tons, while that reported for the year ending June 1, 1897, is 17,078 tons, having an estimated value of $581,528.

July 1, 1896, balance unexpended	$3,644.31
June 30, 1897, amount expended during fiscal year	1,325.79
July 1, 1897, balance unexpended	2,318.52
July 1, 1897, outstanding liabilities	200.00
July 1, 1897, balance available	2,118.52
Amount required for maintenance in fiscal year ending June 30, 1899	2,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix V 5.)

6. St. Francis River, Arkansas.—This river was, prior to improvement, obstructed by snags, drift, overhanging timber, and shoals. The adopted project has been for the usual snagging operations.

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From the various appropriations for this stream there had been expended to June 30, 1896, $50,657.11.

This has resulted in materially improving the navigation of the stream.

During the fiscal year ending June 30, 1897, the hand snag boat *A. B. Johnson* has been rebuilt. Backwater from the Mississippi River was well up the St. Francis River by the time the *A. B. Johnson* was completed and little was done in the way of snagging operations. Survey to determine the practicability of improvement of this stream by locks and dams was begun, but was not completed because of the backwater from the Mississippi River interfering with the accurate determinations of low-water elevations and the character of the foundations at possible lock locations.

Timber and cooperage stuffs make up the greater portion of the commerce reported. The reports for the last four years show regular increase in nearly all articles transported. The total commerce for the year ending May 31, 1897, is given as 97,348 tons, value estimated at $1,117,891.

July 1, 1896, balance unexpended	$8,342.89
June 30, 1897, amount expended during fiscal year	5,125.00
July 1, 1897, balance unexpended	3,217.89
July 1, 1897, outstanding liabilities	125.00
July 1, 1897, balance available	3,092.89
Amount (estimated) required for work annually	8,000.00
Amount that can be profitably expended for maintenance in fiscal year ending June 30, 1899	8,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix V 6.)

7. St. Francis River, Missouri.—Before improvement this section of the river was obstructed by snags and overhanging timber to such an extent as to render navigation impracticable.

The project for its improvement provides for the usual snagging operations.

Under this project there had been expended to June 30, 1896, $18,281.12. Navigation above St. Francis was made easier at medium and high stages and a fair channel for 2-foot navigation at low water was opened from Dunklin County Cut-off to St. Francis.

During the fiscal year the U. S. snag boat *Missouri* (hand propelled) worked twice over the river between St. Francis and Freeman Place (20 miles above); lack of funds prevented further operations. A fair steamboat channel was opened for navigation at stages that allow boats to pass over the shoals.

Drift and sunken logs accumulate rapidly in this stream and it is reported as again in bad condition, the snagging operations giving only temporary relief.

The commerce on this stream arises from timber industries. The tonnage for the year ending May 31, 1897, is reported as 23,306 tons, value estimated at $75,421. The average of tonnage reported for the last four years is 29,234 tons, and it is believed full report was not received for this year.

July 1, 1896, balance unexpended	$2,218.88
June 30, 1897, amount expended during fiscal year	2,158.35
July 1, 1897, balance unexpended	60.53
July 1, 1897, outstanding liabilities	60.53

(See Appendix V 7.)

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EXAMINATION AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The preliminary examination and surveys of the following localities, required by the act of June 3, 1896, were made by the local engineer, Capt. William L. Sibert, Corps of Engineers, and reports thereon submitted:

1. Preliminary examination of Neosho River, Kansas, from the north line of Neosho County to the south line of Labette County.—Captain Sibert submitted report of examination November 24, 1896. In his opinion, concurred in by the division engineer, Col. J. W. Barlow, Corps of Engineers, and by the Chief of Engineers, Neosho River is not worthy of improvement by the United States. The report was transmitted to Congress and printed in House Doc. No. 80, Fifty-fourth Congress, second session. (See also Appendix V 8.)

2. Surveys of Arkansas River at Little Rock, Vanburen, and Fort Smith, Ark.—The act of June 3, 1896, authorized examinations and surveys to be made at or near these localities, to determine whether or not, by reason of dikes or other Government works, any part of the harbors or river banks in their vicinity has been so injured or endangered that the Government should guard against or remedy the same. Captain Sibert submitted report March 10, 1897, concerning the examinations and surveys thus provided for. He states that the Government works in the vicinity of Fort Smith have not so injured the harbor or river banks there that the Government should guard against or remedy the same, and that the filling up of the harbor and the caving of the banks at Vanburen and the caving of the bank in the vicinity of Little Rock are due to natural agencies and not caused by the Government works at those places. It is his opinion that further surveys at the three localities mentioned are not necessary. The views and recommendations of the local officer are concurred in by the division engineer, Colonel Barlow. The report was transmitted to Congress and printed in House Doc. No. 24, Fifty-fifth Congress, first session (See also Appendix V 9.)

3. Survey of Arkansas River at Pinebluff, Ark.—The act of June 3, 1896, authorized examinations and surveys to be made of the Arkansas River at or near Pinebluff to determine whether or not, by reason of dikes or other Government works, any part of the harbor or river banks in that vicinity has been so injured or endangered that the Government should guard against or remedy the same. Captain Sibert submitted report upon the subject February 8, 1897. It is his opinion that the dikes and bank protection at Pinebluff have not injured the river banks or harbor, but that such work has preserved the city from destruction. He states that the work below Dike No. 2 should be kept in repair, so that it will form a part of a complete system of regulation works; and such work has been authorized, funds being available for the purpose. The report was transmitted to Congress and printed in House Doc. No. 294, Fifty-fourth Congress, second session. (See also Appendix V 10.)

4. Survey of White River from Batesville to Buffalo Shoals, Arkansas, with a view to improving by slack-water navigation.—Captain Sibert submitted report November 28, 1896. He states that the difference of elevation between Batesville and Buffalo Shoals (145.3 feet) can be overcome by ten locks, which will cost, with the necessary dams, $1,600,000. This estimate is based on the supposition that there will be funds available sufficient to construct a lock and dam complete each

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working season when work is once commenced. The report was transmitted to Congress and printed in House Doc. No. 78, Fifty-fourth Congress, second session. (See also Appendix V 11.)

5. Survey of Buffalo Fork of White River, Arkansas, from its mouth to mouth of Rush Creek, with a view to determine what character and extent of improvement is required.—Captain Sibert submitted report of survey January 9, 1897. In his opinion this stream is worthy of improvement to the extent of cutting the overhanging timber and removing from the shoals the loose and solid rock that project above the general plane of the bed of the shoals, from the mouth to the mouth of Rush Creek. The work is estimated to cost $3,500. The views of the local officer are concurred in by the division engineer, Colonel Barlow. The report was transmitted to Congress and printed in House Doc. No. 207, Fifty-fourth Congress, second session. (See also Appendix V 12.)

6. Survey of St. Francis River, Arkansas and Missouri, from the Sunk Lands to Poplin, Mo.—Captain Sibert submitted report November 24, 1896. The data necessary to the preparation of a project being at hand, no survey was made. The plan of improvement proposed is to clear the river of snags, drifts, and overhanging timber, and to confine the river to one channel from the head of the Sunk Lands to Chalk Bluff, and to remove obstructions of the same nature that interfere with navigation at medium and high stages of water from Chalk Bluff to Poplin. The estimated cost of this work is $11,200, and it is estimated that it will require $2,000 per year to remove the annual accumulation of snags, etc., in this reach of the river after the proposed improvement has been accomplished. The report was transmitted to Congress and printed in House Doc. No. 82, Fifty-fourth Congress, second session. (See also Appendix V 13.)

REMOVING SNAGS AND WRECKS FROM MISSISSIPPI RIVER; IMPROVEMENT OF MISSISSIPPI RIVER BETWEEN THE OHIO AND MISSOURI RIVERS, OF HARBOR AT ST. LOUIS, MO., AND TO PREVENT THE MISSISSIPPI FROM BREAKING THROUGH INTO CACHE RIVER AT BEACH RIDGE ABOVE CAIRO, ILL.

This district was in the charge of Maj. T. H. Handbury, Corps of Engineers, having under his immediate orders Lieut. Charles S. Bromwell, Corps of Engineers, from September 28, 1896, to June 20, 1897. Division Engineers, Col. J. W. Barlow, Corps of Engineers, to May 7, 1897, and Col. Henry M. Robert, Corps of Engineers, since that date.

1. Removing snags and wrecks from Mississippi River.—Before this work was inaugurated the navigation of the river was very much interfered with by numerous snags, logs, etc., which had lodged in the channel, and to which a new accession was brought down on each rise of the river, thus constantly adding new and unknown obstructions to those already there. A large number of wrecks dangerous to navigation also occupied the channel.

For the removal of these obstructions appropriations were made as early as 1824, and the project adopted consisted of building boats suitable for removing the snags, etc., and operating them whenever the stage of water was favorable for the work and funds were available.

The total amount expended for this purpose can not be definitely given, as previous to the appropriation made by act of March 3, 1879, a general amount was appropriated to be applied to several streams as their needs required. From March 3, 1879, when the first specific appropriation was made, up to June 30, 1896, $1,199,506.72 had been expended for this purpose. This expenditure materially improved the

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navigation of the river and lessened the danger to boats. During the fiscal year ending June 30, 1897, the sum of $83,421.64 was expended upon the improvement. Two snag boats were employed in removing the obstructions to navigation between St. Louis and New Orleans, and the work resulted in removing 3,072 snags, cutting down 31,014 trees, removing 24 drift piles and 2 wrecks; total distance traveled, 15,978 miles.

The work accomplished during the year has been of great benefit to navigation and commerce. Formerly the wrecking of steamboats from running against snags was of frequent occurrence, but since the snag boats have been regularly at work it is unusual to hear of a boat being sunk by a snag.

An annual appropriation not to exceed $100,000 for carrying on this work was made by the act of August 11, 1888. Under this appropriation the two snag boats will patrol the river and remove obstructions wherever necessary.

Amount drawn under section 7, act of August 11, 1888	$83,421.64
June 30, 1897, amount expended during the fiscal year	83,421.64
July 1, 1897, amount available for fiscal year 1897-98	100,000.00

(See Appendix W 1.)

2. Mississippi River between Ohio and Missouri rivers.—The original condition of the navigable channel of this portion of the Mississippi River before the work of improvement was begun was such that the natural depth at low water was in many places from 3½ to 4 feet. The channels were divided by islands, which formed sloughs and secondary channels, through which a good deal of the volume of the flow was diverted, to the detriment of navigation.

The first work for improvement began in 1872, and was continued for a number of years as appropriations were made, the works consisting of dikes and dams of brush and stone, erected with a view to confining the low-water volume to a single channel, and of revetments to hold and preserve the banks where necessary or advisable to do so.

The present project is a continuation of the plan adopted in 1881. It also contemplates confining the volume of the river at low water to a single channel, its approximate width to be, below St. Louis, about 2,500 feet, the natural width being in many cases from 1 to 1½ miles. The method principally employed is the closing of sloughs and secondary channels and building up of new banks out to the line desired from the solid matter brought down by the river and which is collected by means of hurdleworks. The banks, both new and old, are revetted where necessary.

The object of the improvement is to eventually obtain a minimum depth at standard low water of 6 feet from the mouth of the Missouri to St. Louis, and of 8 feet from St. Louis to the mouth of the Ohio.

The original estimate of the cost of the improvement, as revised in 1883, is $16,397,500.

The total amount expended to June 30, 1896, was $6,571,488.91, exclusive of $180,000 allotted by acts and projects for improvement between the Illinois and the Missouri rivers, including Alton Harbor. It resulted in extending the improvement in a partially completed condition to Red Rock, Mo., 87 miles below St. Louis.

The work done during the last year in the line of the permanent improvement has consisted in repairs to existing contraction works and

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revetment and a further extension of the same in localities where work had already been commenced.

New work was commenced a few miles below Commerce, where there is a very bad stretch of low-water navigation. This consisted of a hurdle dam placed across Doolans Slough, separating Powers Island from the Missouri shore, which took off about one-half the low-water discharge of the river.

This resulted in a marked improvement in low-water navigation through this reach.

The river and harbor act of June 3, 1896, provided for the expenditure of $30,000 in the vicinity of Chester, Ill. A low-water revetment was placed against the bank opposite this place for a distance of 3,310 feet, and rock revetment carried up the slope to the 10-foot contour. There is still remaining unexpended of this amount sufficient to carry this revetment to the 20-foot contour above low water.

In this same act it was provided that "there may be expended, under the direction of the Secretary of War, not exceeding $50,000, or so much thereof as may be necessary, in order to improve the channel of the river, and to protect the east bank of the Mississippi River from caving in and being washed away at or near a point opposite the mouth of the Missouri River and extending south along said east bank." Pending a consideration of the necessity for this work in the interest of navigation the allotment remains unexpended.

Work in the nature of portable jetties and dredging for the temporary improvement of the channel was done in the vicinity of Chain of Rocks, Harrisonville, Calico Island, Turkey Island, Ste. Genevieve, Seventy-Six Landing, Grand Tower Bend, Schenimans, Goose Island, and Hackers Bend. In all of these localities the channel depths were increased from 1 to 3 feet.

For this temporary improvement of the channels through shoal reaches there is now in store 9,000 feet of portable jetty, or sufficient for nine jetties each 1,000 feet in length. A party and outfit on the ground can put this in place at the rate of 400 feet per day. The cost of these jetties, including material, putting in place, removing and storing, and all other expenses, does not exceed $4.50 per linear foot.

Two towboats have been arranged so that they can stir up the sand on shoal bars with their wheels and wash it into deep pools below. One of these is supplied with large jet pumps. One jet-dredge was designed especially for throwing a broad sheet of water with considerable velocity upon these bars, thus washing them downstream and increasing the depth of water over them. These are the temporary expedients resorted to with good results during the last low-water season.

For the coming season there is provided in addition to these a hydraulic dredge capable of removing 500 cubic yards of sand per hour and depositing it at a distance of 500 feet on either side of the channel. This dredge was completed about the close of last low-water season.

There is also under contract and in process of construction two steel-hulled hydraulic dredges, designed in accordance with the results of the latest developments in this line of machinery. These are to be completed about the middle of October, and will each have a capacity of 1,000 cubic yards per hour.

With these appliances to aid the work put in place for the permanent improvement of the channel, it is confidently expected that at least 6 feet depth will be maintained during the coming low-water season between St. Louis and Cairo.

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The funds now available will be expended in carrying out the original project and in the temporary work required by the river and harbor act of June 3, 1896.

The sum asked for the fiscal year ending June 30, 1898, will be applied to a continuance of the same work.

To prevent the suspension of this important work for lack of funds the river and harbor act of June 3, 1896, makes provision for three years' work from July, 1897, to be paid for as appropriations are made by law, at the rate of $673,333.33 annually.

July 1, 1896, balance unexpended	$608,511.08
Amount appropriated by sundry civil act approved June 4, 1897	673,333.33
	1,281,844.41
June 30, 1897, amount expended during fiscal year	499,325.48
July 1, 1897, balance unexpended	782,518.93
July 1, 1897, outstanding liabilities	1,952.11
July 1, 1897, balance available	[1]780,566.82

Amount (estimated) required for completion of existing project	8,544,166.68
Amount that can be profitably expended in fiscal year ending June 30, 1899, as authorized by river and harbor act of June 3, 1896	673,333.33
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix W 2.)

3. Harbor at St. Louis, Mo.—St. Louis Harbor is about 18 miles long and divided into two nearly equal parts by the Eads Bridge. The upper part, included between the bridge and the northern limits of the city, is about 10 miles in length.

Three miles above the Eads Bridge is the Merchants' Bridge. The lower part of the harbor, included between Eads Bridge and the River Des Peres, is 8 miles long. The channel in this part of the harbor has sufficient depth and accessible landings at all points. Good depth exists above the Merchants' Bridge.

Congress by act approved September 19, 1890, appropriated $182,000 for improvement of this harbor.

The navigable reach between the Eads Bridge and Merchants' Bridge was at that time obstructed by a number of middle bars. The project adopted for improvement of the harbor under the appropriation of 1890 consisted in a contraction of the waterway between those bridges to a width of about 2,000 feet, in order to concentrate the flow upon the bars, and thus cause scour to the depth desired. The contraction works consisted of a series of hurdles extending out from the Illinois shore, the object of the hurdles being to collect deposits of material brought down during floods, and thus build up a new bank to the line desired.

This work, which was accomplished by the close of the fiscal year ending June 30, 1892, caused extensive deposits of sediment along the

[1]Of this balance special allotments have been made by Congress as follows:

Bank protection at Cairo, Ill., act of July 5, 1884 (balance)	$8,600.00
Continuing improvement at Cape Girardeau, Mo., act of August 5, 1886 (balance)	22,500.00
Removing bar in front of Chester, Ill., and protecting west bank of river opposite Chester, act of June 3, 1896 (balance)	6,155.82
Bank protection on east side of Mississippi River opposite mouth of Missouri River, act of June 3, 1896	50,000.00
Total	87,255.82

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line of hurdles, and has resulted in considerable increase in channel depth, with corresponding benefit to navigation.

Amount expended to July 1, 1896, $150,762.03. There was no expenditure during the past fiscal year.

The full amount of the estimate for the improvement of this part of the harbor has been appropriated. With the balance remaining it is proposed to repair damage that may occur to the hurdles from ice and drift and to extend them wherever found necessary to do so.

July 1, 1896, balance unexpended	$31,237.97
July 1, 1897, balance unexpended	31,237.97

(See Appendix W 3.)

4. To prevent the Mississippi River from breaking through into the Cache River at or near a point known as Beach Ridge, a few miles above Cairo, Ill.—This is a new work. The sundry civil act approved June 4, 1897, contains an item which reads as follows:

For the purpose of preventing the Mississippi River from breaking through into the Cache River at or near a point known as Beach Ridge, a few miles north of Cairo, whereby the national cemetery at Mound City, at the mouth of the Cache River, and the marine hospital at Cairo would be in imminent danger of destruction, the sum of one hundred thousand dollars, or so much thereof as may be necessary, is hereby appropriated, to be immediately available.

The project for this work not being based on a survey under the Department and the extent of the work contemplated not being known, an estimate of its total cost can not be given. From a study of the conditions involved it would seem that the object of the appropriation can best be carried out by revetting as great a length of the bank of the Mississippi River in the vicinity of Beach Ridge railroad station as the funds will suffice, and a project for such work has been approved.

No work has been done and no part of the funds has been expended.

Amount appropriated by sundry civil act approved June 4, 1897	$100,000.00
July 1, 1897, unexpended	100,000.00

(See Appendix W 4.)

IMPROVEMENT OF MISSISSIPPI RIVER BETWEEN MOUTH OF MISSOURI RIVER AND MINNEAPOLIS, MINN., AND OF GALENA RIVER, ILLINOIS.

This district was in the charge of Lieut. Col. W. R. King, Corps of Engineers, having under his immediate orders Lieut. Charles Keller, Corps of Engineers.

1. Operating snag boats and dredge boats on Upper Mississippi River.—At the beginning of the fiscal year there was available, under act of August 11, 1888, the sum of $25,000.

From March 26 to November 13, 1896, and from March 26 to June 30, 1897, the snag boat *General Barnard* was employed in removing snags and other obstructions and otherwise assisting interests of navigation between Minneapolis and the mouth of Missouri River. Dredges *Vulcan* and *Phœnix* were employed at times on similar work.

The total amount expended for snag-boat service to June 30, 1896, is $724,640.

By the river and harbor act of August 11, 1888, provision was made for operating snag boats and dredge boats on the Upper Mississippi River under a permanent appropriation, the sum so expended not to exceed $25,000 annually.

The total amount of freight transported on the Upper Mississippi River during calendar year 1896 was about 2,250,000 tons.

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The amount expended during the fiscal year ending June 30, 1897, was $25,000.

(See Appendix X 1.)

2. Mississippi River between Missouri River and Minneapolis, Minn.—Under this head is carried on the improvement of through navigation.

Systematic work began in 1878, and such good results have been secured as to demonstrate that with a continuance of operations under liberal appropriations the low-water channel of the Mississippi River between St. Paul and the Missouri River can be made sufficiently deep, available, and permanent to satisfy the demands of commerce. The navigation interests are very large and important. The amount of freight carried during 1896, including logs and lumber, was, approximately, 2,250,000 tons.

The original condition of the channel between the Missouri River and St. Paul was such that in low stages the larger boats were unable to proceed farther up the river than La Crosse or Winona, and in many seasons at points much lower down their progress was checked or seriously hindered. In all such cases through freight was reshipped on small and light-draft boats or barges.

The originally adopted project for the improvement, which has not been materially changed, proposed the contraction of the channel or waterway by means of wing and closing dams to such an extent as, by means of the scour thereby caused, to afford a channel of sufficient width and of a depth of 4.5 feet at low water, to be eventually increased to 6 feet by further contraction.

There was expended on the improvement to June 30, 1896, the sum of $6,846,183.82. At that date, and for several years previous, the condition of the channel was such as to permit the passage of the largest boats at very low stages through to St. Paul.

During the past year work has been carried on by hired labor and use of Government plant between St. Paul and Lake Pepin, at Kings Coulee, between Reeds Landing and Genoa, at Rock Island Rapids and Harbor, between Keithsburg and Nashville, between Quincy and Clarksville, at Quincy Bay and Harbor, at Sny Island Levee, and between the Illinois and Missouri rivers; under formal contract, between Genoa and Prairie du Chien, between Dubuque and Clinton, at East Dubuque Harbor, between Rock Island and Muscatine, between Hamburg and Cap au Gris, between Cap au Gris and the Illinois River, and at the Flint Creek and Warsaw levees.

The amount expended for channel improvement during the year was small, as a great part of the funds was diverted to special work, but an increase of depth of not less than 1 foot was obtained at several localities.

As regards the Flint Creek to Iowa River levee, the estimate under approved project is $250,000, of which $210,000 has been appropriated. Twenty-two of the 36 miles is now completed, and the balance of the estimate ($40,000), if appropriated, will complete the work. For La Crosse Harbor the estimate is $17,000, of which $5,000 is appropriated. The balance of $12,000 is needed to complete the improvement.

To prevent the suspension of this important work for lack of funds the river and harbor act of June 3, 1896, makes provision for three years' work from July, 1897, to be paid for as appropriations are made by law, at the rate of $826,666.67 annually.

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July 1, 1896, balance unexpended		$581,316.19
Amount appropriated by sundry civil act approved June 4, 1897		826,666.67
Received from nonpayments		95.62
		1,408,078.48
June 30, 1897, amount expended during fiscal year		426,947.58
July 1, 1897, balance unexpended		981,130.90
July 1, 1897, outstanding liabilities	$35,661.11	
July 1, 1897, amount covered by uncompleted contracts	3,401.34	
		39,062.45
July 1, 1897, balance available		942,068.45
Amount that can be profitably expended in fiscal year ending June 30, 1899, as authorized by river and harbor act of June 3, 1896. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		826,666.67

(See Appendix X 2.)

3. Operating and care of Des Moines Rapids Canal and Dry Dock.—During the past year the Des Moines Rapids Canal was open for navigation 252 days, during which time there passed through it 760 steamboats and 272 barges, carrying 21,778 passengers, 40,365 tons of merchandise, and 54,345 bushels of grain. There also passed through the canal 101,649,575 feet B. M. of lumber, 13,616,000 feet of logs, 28,866,520 shingles, and 28,834,228 laths.

The dry dock was in constant use during the whole year.

The cost of operating and care of the canal is provided for by an indefinite appropriation made by act of March 3, 1881.

The amount expended during the year was $36,180.04, including outstanding liabilities.

(See Appendix X 3.)

4. Operating and care of Galena River improvement, Illinois.—This improvement, consisting of a lock and dam in the Galena River, was purchased by the United States in March, 1894, under provisions of act of Congress of September 19, 1890, at a cost of $100,000. During the past year the lock was open for navigation 236 days, during which time there passed through it 265 steamboats and barges, carrying 714 passengers and 1,679 tons of merchandise. The cost of operating and care of the improvement is provided for under indefinite appropriation made by act of Congress approved July 5, 1884.

The amount expended during the year was $8,758.20, including outstanding liabilities.

(See Appendix X 4.)

5. Mississippi River between St. Paul and Minneapolis, Minn.: Construction of Lock and Dam No. 2.—By river and harbor act of August 17, 1894, authority was given for commencement of improvement of the river between St. Paul and Minneapolis by slack-water navigation. The original condition of the channel was such that at low stages it was navigable by very small boats only, and at all stages the current was so swift for about 3 miles that boats were unable to make headway against it. These conditions still prevail.

The originally adopted project, as yet unchanged, was the construction of Lock and Dam No. 2, near Meekers Island, to carry slack water from that point to Washington Avenue Bridge at Minneapolis. The esti-

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mated cost was $598,235. The amount expended on this project to the close of the fiscal year ending June 30, 1896, was $11,556.50. At present there is but little river commerce between St. Paul and Minneapolis, but it is expected that this improvement will develop a large down-river traffic, chiefly in logs, lumber, flour, and grain, and a fair up-river transportation of general merchandise.

During the year some additional examinations and borings were made and a part of the needed lands and flowage rights was secured. The money now available being sufficient to build lock foundation, operations can commence as soon as all preliminary arrangements regarding land and flowage rights are provided for.

July 1, 1896, balance unexpended	$189,321.17
June 30, 1897, amount expended during fiscal year	4,565.13
July 1, 1897, balance unexpended	184,756.04
July 1, 1897, outstanding liabilities	301.88
July 1, 1897, balance available	184,454.16

Amount (estimated) required for completion of existing project ..... [1]397,357.33
Amount that can be profitably expended in fiscal year ending June 30, 1899 397,357.33
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix X 5.)

SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The surveys of the following localities, required by the act of June 3, 1896, were made by the local engineer, Lieut. Col. W. R. King, Corps of Engineers, and reports thereon submitted:

1. Survey of east bank of Mississippi River between Oquawka and Dallas City, Ill., with a view to the improvement of navigation by preventing the overflow of the natural and artificial banks and by deepening the channel.—Lieutenant-Colonel King submitted report of survey December 21, 1896. The project presented contemplates the construction of levees about 40 miles long, and he estimates the cost at $340,250. He states at some length the advantages to be derived from the proposed levee as a protection to land subject to overflow, but is of opinion that the construction of such banks as proposed will not be of any benefit to navigation. The Chief of Engineers concurs in this opinion. Attention is invited to the suggestion of the local officer that if this work is undertaken by the General Government, the right of way should be donated to the United States. The report was transmitted to Congress and printed in House Doc. No. 159, Fifty-fourth Congress, second session. (See also Appendix X 6.)

2. Survey of east side of Mississippi River between Drurys Landing and New Boston, Ill., with a view to the improvement of navigation by preventing the overflow of the natural and artificial banks and by deepening the channel.—Lieutenant-Colonel King submitted report of survey January 8, 1897. The project presented contemplates the construction of a levee about 30 miles long, and he estimates the cost at $243,245. He states the advantages to be derived from the proposed levee as a protection to land subject to overflow, but is of the opinion that the construction of such banks as are proposed will not be of any benefit to

[1] The amount reported in the Annual Report for 1896 was erroneous and should have been $397,357.33.

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navigation, and this opinion is concurred in by the Chief of Engineers. Attention is invited to the suggestion of the local officer that if this work is undertaken by the General Government, the right of way should be donated to the United States. The report was transmitted to Congress and printed in House Doc. No. 212, Fifty-fourth Congress, second session. (See also Appendix X 7.)

3. Survey of La Crosse Harbor, Wisconsin.—Lieutenant-Colonel King submitted report of survey January 11, 1897. The plan of improvement proposed is to build a dam or bulkhead of brush and rock in the Mississippi River 1,575 feet long. A smaller dam of similar material, 450 feet long, is provided for, and is intended to catch deposits from La Crosse River. Provision is also made for dredging the bar on the Mississippi River side of the proposed long dam to a depth of 4½ feet below low water and for depositing the dredged material on the inside of the bulkhead. Certain other filling, to be done at the expense of the city of La Crosse, is also provided for. The work outlined to be undertaken by the United States is estimated to cost $17,000. Attention is invited to the recommendation of the local officer that if it is thought advisable to appropriate funds for this improvement, a proviso be added that no expenditure be made for the purpose by the United States until the city of La Crosse shall have taken the necessary steps to carry the sewers across the area to be filled in so as to discharge outside of the bulkhead proposed. The report was transmitted to Congress and printed in House Doc. No. 210, Fifty-fourth Congress, second session. (See also Appendix X 8.)

4. Survey of west side of Mississippi River, commencing near Lagrange, above high water, and running along the bank of the river to near the railroad bridge over Mississippi River above Hannibal, Mo., with the view of improving navigation by preventing the water from overflowing the natural and artificial banks along that part of the river and deepening the channel.—Lieutenant-Colonel King submitted report of survey January 20, 1897. The project submitted contemplates the construction of levees, at an estimated cost of $341,761. The local officer states the advantages to be derived from the proposed levees as a protection to land subject to overflow, but expresses the opinion that the construction of such banks as proposed will not be of any benefit to navigation, and this opinion is concurred in by this office. Attention is invited to the suggestion that if this work is undertaken by the General Government, right of way should be donated to the United States. The report was transmitted to Congress and printed in House Doc. No. 244, Fifty-fourth Congress, second session. (See also Appendix X 9.)

5. Survey of Egyptian Levee along the south bank of Des Moines River to or near Mississippi River at Alexandria, Mo.; thence along the west bank of said river to terminus of said Egyptian Levee; and estimate of cost of raising and strengthening said levee so as to confine the water to the river and thereby deepen the channel and improve navigation.—Lieutenant-Colonel King submitted report of survey January 18, 1897. The project submitted contemplates the raising and strengthening of existing levees and the building of new ones where needed, at an estimated cost of $285,500. The advantages to be derived from the proposed levees as a protection to land subject to overflow are set forth, but in the opinion of the local officer the construction of such banks as proposed will not be of any benefit to navigation, and this opinion is concurred in by this office. Attention is invited to the suggestion that if this work is undertaken by the General Government, the right of way should be donated to the United States. The report was trans-

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mitted to Congress and printed in House Doc. No. 223, Fifty-fourth Congress, second session. (See also Appendix X 10.)

6. Survey of west side of Mississippi River from the bluff above the city of Fort Madison to the mouth of Skunk River, Iowa, with a view of improving the navigation by preventing the overflow of the natural and artificial banks and by deepening the channel.—Lieutenant-Colonel King submitted report of survey December 23, 1896. The project submitted contemplates the construction of levees about 18 miles long, at an estimated cost of $135,635. The advantages to be derived from the proposed levees as a protection to land subject to overflow are set forth, but it is the opinion of the local officer that the construction of such banks as proposed will not be of any benefit to navigation, and this opinion is concurred in by the Chief of Engineers. Attention is invited to the suggestion that if this work is to be undertaken by the General Government, the right of way should be donated to the United States. The report was transmitted to Congress and printed in House Doc. No. 148, Fifty-fourth Congress, second session. (See also Appendix X 11.)

7. Survey of west bank of Mississippi River from mouth of Iowa River to Muscatine, Iowa, with a view of improving the navigation by preventing the overflow of the natural and artificial banks and by deepening the channel.—Lieutenant-Colonel King submitted report of survey January 2, 1897. The project submitted contemplates the construction of a levee about 24½ miles long, at an estimated cost of $139,800. The advantages to be derived from the proposed levees as a protection to land subject to overflow are set forth, and it is the opinion of the local officer that the construction of such banks will not be of any benefit to navigation, and this opinion is concurred in by the Chief of Engineers. Attention is invited to the suggestion that if this work is to be undertaken by the General Government, right of way should be donated to the United States. The report was transmitted to Congress and printed in House Doc. No. 208, Fifty-fourth Congress, second session. (See also Appendix X 12.)

CONSTRUCTION OF RESERVOIRS AT HEAD WATERS OF MISSISSIPPI RIVER; IMPROVEMENT OF RIVERS IN WISCONSIN AND MINNESOTA TRIBUTARY TO MISSISSIPPI RIVER, AND OF RED RIVER OF THE NORTH, MINNESOTA AND NORTH DAKOTA; GAUGING MISSISSIPPI RIVER AT ST. PAUL, MINN.

This district was in the charge of Lieut. Col. W. A. Jones, Corps of Engineers.

1. Construction of reservoirs at head waters of Mississippi River.—The object of these reservoirs is to collect surplus water, principally from precipitation of winter, spring, and early summer, to be systematically released so as to benefit navigation on the Mississippi River below the reservoir dams.

Improvement of navigation of the Mississippi by means of reservoirs has been the subject of a number of reports, preliminary and otherwise, from 1870 to 1881, both years inclusive. In the report of 1881 the total cost of the reservoir dams discussed (about 41 in all) for the head waters of the Mississippi, Saint Croix, Chippewa, and Wisconsin rivers, was placed at $1,809,083.50, exclusive of land damages. This estimate, at the best, was approximate. The estimate of cost of the proposed dams at the head waters of the Mississippi River in Minnesota was $573,660.08, the materials for construction to be mainly the timber and earth found in the country.

Later rearrangement of dams and revision of estimates brought the

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estimated cost of the reservoir dams at the head waters of the Mississippi River to about $675,000.

These dams are as follows: At Lake Winnibigoshish, Leech Lake, Pokegama Falls, Sandy Lake, Pine River, and Gull Lake. All of them have been completed excepting that for Gull Lake, which has not as yet been commenced.

The total amount expended to the close of the fiscal year ending June 30, 1896, was $820,125.03. These expenditures cover cost of construction of five dams and their operating machinery, of superintendence and contingencies, of certain awards for damages, and of repairs; also of operating the dams up to February 1, 1895.

The expenditure has resulted in benefit during the low-water season to the navigable portions of the Mississippi River from Grand Rapids, Minn., to the confluence of the Mississippi and St. Croix rivers, about 22 miles below St. Paul.

The work of the past fiscal year consisted mainly in preparations for purchase of flowage rights, as a preliminary to the commencement of construction of the proposed Gull Lake Dam, and in surveys of reservoir sites. A small steamer was built for service at Pokegama Falls, Leech Lake, and Lake Winnibigoshish reservoirs. Amount expended during the year, $13,328.58.

For commerce benefited by the reservoirs, reference must be made to the commercial statistics of the Upper Mississippi River.

The construction of reservoirs has been confined to Minnesota, for reasons stated in Appendix Y to the Annual Report of the Chief of Engineers for 1886.

A résumé of the subject is given in the report of The Board of Engineers, printed in Appendix A A 4 to the Annual Report of the Chief of Engineers for 1887.

The reservoir dams at Lake Winnibigoshish and Leech Lake, which were commenced fifteen and completed thirteen years ago, are reported as greatly in need of repair. Twelve to fifteen years is about as long as the timber portions above water, constructed of pine, should be left without either renewal of the exposed timber or, at least, extensive repairs. An estimate of the needs of the dams in the way of renewal or thorough repair will be made during the present season. The officer in charge estimates that needed repairs at these dams will cost, approximately, $225,000.

The officer in charge reports that, from a recent examination of Pine River Reservoir, three dikes will be required, in order that there may be no escape of water when that reservoir is full. The cost of the dikes he estimates as $10,000.

The estimated cost of the dams, the construction of which it is understood Congress has authorized, not including land damages nor cost of maintenance and repairs for many years, was placed, approximately, at $675,000. There has been expended, including repairs, etc., $833,453.61. It is estimated a further appropriation of $35,000, in addition to $55,000 now reserved, will complete the Gull Lake Reservoir, the only new work at present contemplated.

As it appeared from a recent letter of the Secretary of the Interior that certain lands situate in the Chippewa Indian Reservation, in Minnesota, would soon be ready for disposal, attention was invited by letter of December 10, 1896, to previous correspondence in which Congress was urged to take some action for the protection of the interests of the United States in the sale and disposal of these lands.

In view of the magnitude of the public interests involved, favorable

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action by Congress, along the lines set forth in the correspondence referred to, was recommended.

The letter and accompanying papers were printed in House Doc. No. 133, Fifty-fourth Congress, second session.

July 1, 1896, balance unexpended	$85,374.97
June 30, 1897, amount expended during fiscal year	13,328.58
July 1, 1897, balance unexpended	72,046.39
July 1, 1897, outstanding liabilities	451.89
July 1, 1897, balance available	71,594.50
Amount that can be profitably expended in fiscal year ending June 30, 1899	35,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix Y 1.)

2. Operating and care of reservoirs at head waters of Mississippi River.—The river and harbor act of August 18, 1894, made applicable to the reservoirs at head waters of Mississippi River, "so far as concerns their care, preservation, and maintenance," the provisions of the general appropriation for "operating and care of canals and other works of navigation, indefinite," contained in section 4 of the river and harbor act of July 5, 1884. The first allotment was made January 25, 1895, and the expenses from February 1, 1895, have been paid from the indefinite appropriation.

During the past year the reservoirs were operated with the usual advantage to the Upper Mississippi River interests.

Ordinary repairs were made to the Sandy Lake, Pokegama Falls, Leech Lake, and Lake Winnibigoshish dams, at an expense of $5,125.29.

Extraordinary repairs were made to the Pine River Reservoir by closing the crevasse formed June 17, 1896, with a permanent earth dike, at a cost of $9,747.24. The total expense of the temporary brush and stone dam at crevasse, commenced in June, 1897, and completed in July, 1897, and of the permanent earth dike was $12,801.19.

Hydrological observations were continued.

The amount expended in care and maintenance of these reservoirs during the past year was $37,155.73.

For commercial statistics reference must be made to the reports upon the Mississippi River.

(See Appendix Y 2.)

3. Chippewa River, including Yellow Banks, Wisconsin.—The project adopted January, 1875, for improvement consists in revetment of caving bends and construction of dams and jetties to confine the low-water volume to one channel. The object is to provide an open channel 200 feet wide and 3 feet deep from Eau Claire to the confluence with the Mississippi River, a distance of 57 miles, and to prevent the erosion of the high sand banks, locally termed Yellow Banks, and thus relieve the channel of the Chippewa River, and of the Mississippi River below the junction of the two streams, from the sand contributed by those banks. Original estimate of cost, $139,892.50. It was revised in 1883, 1887, and 1888. (See annual reports for those years.) The last revision placed the cost at $272,487.72.

All the work for channel improvement, except the removal of 10 piers and the construction of 1 wing dam at Eau Claire, has been done on the portion of the river below Waubeek Yellow Banks, 20 miles in length. The effect has been to provide a channel 3 feet deep over the bar at the mouth of the river and materially increase the depths over

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the Durand, Plum Island, Eau Galle Flats, Plum Island Flats, Battle Island, Wacouta Island, and Flower Pot Island bars, besides straightening a difficult piece of river at Madison Street Bridge, in Eau Claire, and the stoppage of a dangerous cut-off at Dead Lake.

The full object has been permanently attained only at the mouth of the river, which originally was the shallowest place; but it may be said that the works for channel improvement admit of raft navigation (the only navigation, except that of running loose logs, on the river) from Eau Claire down, except during abnormally low stages. About one-fifth of the Yellow Banks has been protected.

Amount expended to June 30, 1896, $180,746.91.

During the past year repairs were made to Wacouta Island Dam No. 2.

Previous to 1884 several steamboats did a thriving business on the river, carrying passengers and general merchandise. Since that year the river traffic has been confined to the rafting of manufactured lumber and the running of loose logs. The annual tonnage of rafted lumber is 300,000 tons, and of loose logs 1,000,000 tons.

July 1, 1896, balance unexpended	$11,003.09
June 30, 1897, amount expended during fiscal year	3,112.66
July 1, 1897, balance unexpended	7,890.43
July 1, 1897, outstanding liabilities	27.62
July 1, 1897, balance available	7,862.81
Amount (estimated) required for completion of existing project	80,737.72
Amount that can be profitably expended in fiscal year ending June 30, 1899	80,737.72
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix Y 3.)

4. St. Croix River, Wisconsin and Minnesota.—The project for improvement contemplates removal of snags, bowlders, bars, etc., and the contraction of the low-water channel from Taylors Falls to the head of Lake St. Croix; widening and straightening the channel where it is narrow or tortuous in Lake St. Croix by dredging and contraction works; also the improvement of the harbor and water front of Stillwater, Minn.

The object of the improvement is to furnish an open channel 3 feet deep from Taylors Falls to the confluence with the Mississippi River, 52.3 miles, and better harbor facilities at Stillwater. Estimated cost, $136,700. The river and harbor act of June 3, 1896, added Stillwater Harbor to the project, and appropriated $10,000 for that purpose.

The total expenditures to June 30, 1896, were $112,463.37.

At the time of the adoption of the project the low-water depth in the channel above Stillwater (head of Lake St. Croix) was but 2 feet on many of the bars. Below (south of) Stillwater, i. e., in Lake St. Croix, the channel over the Hudson and Catfish bars was narrow and tortuous. The object of the improvement has been attained on that portion of the river south of Stillwater, 23.8 miles in length, but the required depth is not permanently secured. The object has not been attained at upper end of Stillwater (head of Lake St. Croix) nor above Stillwater. Above Stillwater the navigation at present is almost wholly that of running loose logs, and no effort in recent years has been made to improve this section.

During the past year no construction work was undertaken, the condition of the river and stage of water being sufficient to meet the demands of the navigation interests. Examinations and surveys were made and material assembled in preparation for the season of 1897.

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The commerce on the river below Stillwater consists of tows of rafted logs and lumber. The total tonnage is approximately 2,000,000 per annum. The Government works of improvement have made this commerce possible throughout the open-water period.

July 1, 1896, balance unexpended	$15,036.63
June 30, 1897, amount expended during fiscal year	2,223.82
July 1, 1897, balance unexpended	12,812.81
Amount (estimated) required for completion of existing project	9,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	9,000.00

(See Appendix Y 4.)

5. Minnesota River, Minnesota.—The appropriations to June 30, 1879, were $117,500, and were applied to surveys and to the removal of obstructions between Minnesota Falls and a point 30 miles below Henderson, or 9.9 miles above Carver, to temporarily facilitate navigation during high stages of the river. The rapidly caving banks on the upper section of the stream cause snags and leaning trees to form, so that channels that were cleared of them seventeen years ago are encumbered with them to-day; hence it may be said that no permanent improvement was effected.

High-water navigation was discontinued in the seventies. Of late years a demand has arisen for the low-water improvement of the lower 24 miles of the river from Shakopee to the mouth. With the $10,000 appropriated August 11, 1888, and made available for this stretch of river by the river and harbor act of July 13, 1892, the work was commenced in the fall of 1893 under a project for the construction of a closing dam across the main channel at mouth of the river and reopening the old channel through Fort Snelling chute.

The dam was built and the channel dredged during the fiscal year ending June 30, 1894, but the dam proved to be too low.

Amount expended to June 30, 1896, $127,500.

The expenditures during the past fiscal year were applied to raising the dam 1½ feet and dredging in the Fort Snelling chute. During the three years 1888, 1889, and 1890 the traffic on the lower river amounted to approximately 4,000 tons annually. Between 1891 and 1896, inclusive, there was no navigation worth recording, in consequence of the shallow outlet of the river. The effect of improvements made during the past year has been to encourage several steamboat owners to make arrangements to navigate the river during the season of 1897. At present the outlet is in fair condition, but further expenditures are required to secure the permanency of the work.

July 1, 1896, balance unexpended	$4,000.00
June 30, 1897, amount expended during fiscal year	3,870.45
July 1, 1897, balance unexpended	129.55
July 1, 1897, outstanding liabilities	72.70
July 1, 1897, balance available	56.85
Amount that can be profitably expended in fiscal year ending June 30, 1899 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	11,000.00

(See Appendix Y 5.)

6. Red River of the North, Minnesota and North Dakota.—The present project is the same as the original (adopted December, 1877), except

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that an open-channel improvement was substituted in 1886, by act of Congress, for the proposed lock and dam at Goose Rapids, and the improvement of Red Lake River between Thief River Falls and Red Lake has been added by the terms of the river and harbor act of Congress of June 3, 1896.

The object of the improvement is to provide an open channel on the Red River of the North from Breckenridge to the northern boundary line, 395.5 miles, as follows:

1. Breckenridge to Moorhead, 97 miles; a channel capable of being navigated during high and medium stages of water.

2. Moorhead to Grand Forks, 155 miles; a channel 50 feet wide and 3 feet deep at low water.

3. Grand Forks to the northern boundary line, 143.5 miles; a channel 60 feet wide and 4 feet deep at low water.

Also to provide a 3-foot open-channel improvement of the Red Lake River and Red Lake from Thief River Falls to and including Red Lake, a total distance of 135 miles.

The original estimate of cost was $364,598.17, increased in 1883 to $398,598.17. The estimate was revised in 1887, after Congress had substituted an open-channel improvement for lock and dam at Goose Rapids, and placed at $252,598.37. An increase of the latter to $310,320 was authorized May 8, 1893. Congress in 1896 added $5,000 to the estimate of cost by attaching the improvement of Red Lake River to the project, making the present estimate of cost from commencement of work $315,320. This does not cover cost of project for Red Lake River.

At the time of the adoption of the project navigation on the first division of the Red River of the North was at all times difficult and in low water impossible; the ruling depth on the second division was but 1.5 feet, and on the third division 2 feet. The low-water navigation of Red Lake River was obstructed by bowlders for a distance of 35 miles between Thief River Falls and High Landing and by a bar at outlet of Red Lake.

By June 30, 1896, the object had not been attained on the first division of the Red River of the North, though its condition had been much improved by the removal of snags and overhanging trees. The object was obtained on the third division and on all but 13 miles of the second. No work had been done on Red Lake River.

The total amount expended to June 30, 1896, was $257,462.03.

During the past year 26,204 cubic yards of dredging was done upon the Red River of the North in repairing old channel cuttings that had become partly filled by landslides. No new work was undertaken.

A small derrick fleet was built for use on Red Lake River. It was completed October 28, 1896. The last eight days of the open season of 1896 were employed in removing 104 cubic yards of bowlders. The removal of bowlders will be resumed July 1, 1897.

Amount expended during fiscal year ending June 30, 1897, upon Red River of the North, $7,542.09; upon Red Lake River, $2,647.10.

Navigation on the Red River is confined to comparatively short reaches north and south of Grand Forks, and consists mainly in the transportation of wheat to Grand Forks by two steamboats (100 and 12 tons burden, respectively) and 4 barges. The tonnage during the year 1896 was 17,786 and nearly double that for 1895. In 1882 it was 31,000.

Two large boats are run on Red Lake towing logs. Three small boats run on Red Lake River carrying general merchandise and passengers. In 1895 the freight amounted to 145½ tons; in 1896, to 198 tons.

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July 1, 1896, balance unexpended	$20,537.97
June 30, 1897, amount expended during fiscal year	10,189.19
July 1, 1897, balance unexpended	10,348.78
July 1, 1897, outstanding liabilities	1,187.22
July 1, 1897, balance available	9,161.56
Amount (estimated) required for completion of existing project	37,320.00
Amount that can be profitably expended in fiscal year ending June 30, 1899 submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	37,320.00

(See Appendix Y 6.)

7. Gauging Mississippi River at or near St. Paul, Minn.—The Board of Engineers to whom was referred the project for the application of $37,500, appropriated by the river and harbor act of August 5, 1886, for reservoirs at head waters of Mississippi River, recommended in their report, dated May 24, 1887, "that such gaugings be made at or near St. Paul during the annual operation of the reservoirs as shall determine accurately the discharge at that point at critical periods." (Annual Report, Chief of Engineers, 1887, p. 1692.)

The river and harbor act of August 11, 1888, authorized the gaugings, but none were made until the fall of 1889. Since the latter date gaugings have been made as frequently as the funds available would permit.

During the past fiscal year 208 gaugings have been made.

Amount expended to June 30, 1896, $4,400.

The records indicate that a rise in the river at St. Paul commences in seven or eight days following the release of water from the distributing reservoir at Pokegama Falls, and in about five days thereafter the full effect is felt. The mean time is, therefore, ten days. The rise on the Weather Bureau gauge, St. Paul, due to reservoir water varies between 1 foot and 1.5 feet, depending upon the stage of the river and the quantity of water collected in the reservoirs.

For commercial statistics reference is made to the reports upon the Mississippi River.

Amount allotted for fiscal year ending June 30, 1897	$500.00
Amount allotted for fiscal year ending June 30, 1898	500.00
	1,000.00
June 30, 1897, amount expended during fiscal year	500.00
July 1, 1897, balance unexpended	500.00

(See Appendix Y 7.)

EXAMINATIONS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The preliminary examinations of the following localities, required by the act of June 3, 1896, were made by the local engineer, Lieut. Col. W. A. Jones, Corps of Engineers, and reports thereon submitted.

1. Preliminary examination of Mille Lacs Lake, Minnesota.—The act of June 3, 1896, directed the Secretary of War to cause an examination to be made of Mille Lacs Lake, with a view to the construction of a dam at the outlet on section 33, township 33 north, in range 27 west, in Mille Lacs County, for the aid of navigation on the Mississippi River, the same to be part of the general Upper Mississippi River reservoir system. Lieutenant-Colonel Jones submitted report February 4, 1897. He indicates the practicability of constructing a reservoir at the locality mentioned, but the Chief of Engineers is unable to express the

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opinion at the present time that such a dam is necessary for the aid of navigation on the Mississippi River. It is deemed advisable to defer action in regard to a reservoir at this locality until the absolute effect of those already authorized is fully determined and the necessity for additional reservoirs made more evident. The report was transmitted to Congress and printed in House Doc. No. 305, Fifty-fourth Congress, second session. (See also Appendix Y 8.)

2. Preliminary examination of Otter Tail Lake and Otter Tail River, Minnesota.—The act of June 3, 1896, directed that an examination be made of Otter Tail Lake and Otter Tail River, with a view to the construction of a dam at the outlet of said lake for the purpose of improving the navigation on the Red River of the North. Lieutenant-Colonel Jones submitted report February 6, 1897. He indicates the practicability of constructing a reservoir at this locality, but the Chief of Engineers is unable, with the data now available, to express an opinion as to the amount of improvement to navigation which would result from the construction of the proposed dam, or the relation of cost to the interests of commerce involved. The project is considered worthy to the extent of making a survey which will furnish the information necessary for forming an opinion as to the merits of the improvement proposed. It is estimated that such a survey would cost $3,000. The report was transmitted to Congress and printed in House Doc. No. 325, Fifty-fourth Congress, second session. (See also Appendix Y 9.)

3. Preliminary examination of Red Lake and Red Lake River, Minnesota.—The act of June 3, 1896, directed that an examination of Red Lake and Red Lake River be made, with a view to the construction of a dam with locks at the outlet of said lake for the purpose of improving the navigation of the Red River of the North and said Red Lake River. Lieutenant-Colonel Jones submitted report February 5, 1897. He indicates the practicability of constructing a reservoir at this locality, but the Chief of Engineers is unable, with the data now available, to express an opinion as to the amount of improvement to navigation which would result from the construction of the proposed dam and lock, or the relation of cost to the interest of commerce involved. The project is considered worthy to the extent of making a survey which will furnish the information necessary for forming an opinion as to the merits of the improvement proposed. It is estimated that such a survey would cost $5,000. The report was transmitted to Congress and printed in House Doc. No. 305, Fifty-fourth Congress, second session. (See also Appendix Y 10.)

IMPROVEMENT OF MISSOURI RIVER AT AND ABOVE SIOUX CITY, IOWA, AND OF YELLOWSTONE RIVER, MONTANA AND NORTH DAKOTA.

This district was in the temporary charge of Lieut. Col. W. A. Jones, Corps of Engineers, to August 3, 1896, and in the charge of Capt. J. C. Sanford, Corps of Engineers, since that date. Division Engineers, Col. Henry M. Robert, Corps of Engineers, from August 3, 1896, to May 7, 1897, and Col. J. W. Barlow, Corps of Engineers, since May 7, 1897.

1. Missouri River between Stubbs Ferry, Montana, and the lower limits of Sioux City, Iowa.—The river distance between the above points is 1,660 miles. By its physical characteristics this portion of the river is divided into four sections: The first, Stubbs Ferry to Greatfalls, Mont., 130 miles, is the navigable portion above the "great falls;" the second, Greatfalls to Fort Benton, Mont., 49 miles, is an unnavigable section, occupied by cataracts and dangerous rapids; the third, Fort Benton to Carroll, Mont., 172 miles, known as the "rocky river," contains numerous

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rapids and rock obstructions, but has carried a heavy commerce; the fourth, Carroll to Sioux City, 1,309 miles, known as the "sandy river," is characterized by muddy water, sand bars, and a shifting channel, with easily eroded and constantly eroding banks. Navigation is difficult at low water, due to the too great width of the river in many places. The upper 158 miles forms a transition portion between the "rocky" and "sandy" rivers.

Between Stubbs Ferry and Greatfalls.—This reach consists of two distinct portions. From Stubbs Ferry to just below the town of Cascade, 76 miles, the average slope is 3.73 feet per mile. Numerous rapids and rock obstructions exist in this reach. A channel depth of less than 2.5 feet at low water is found at a number of places (said to be fifteen.) Below this rapid portion the "Long Pool" extends to Greatfalls, 54 miles. The average slope is only 0.52 foot per mile. A channel depth of 3 feet originally existed throughout the pool except at a few bars, most of which are not far from Greatfalls.

In 1880 a small amount of rock removal work had been done at the worst two rapids above Cascade, under an appropriation for improving the Missouri River above the mouth of the Yellowstone River.

The original project, submitted January 23, 1892, contemplated obtaining a channel 3 feet deep at low water from Greatfalls to Cascade and a channel of 2.5 feet low-water depth from Cascade to the canyon next below Stubbs Ferry, at an estimated cost of $115,837.50. The present project, adopted November 30, 1894, increases the estimate to $165,812.50, but contemplates the same results.

There had been expended on this project to June 30, 1896, $19,776.05, by which a channel of the proposed depth had been obtained from Greatfalls to Wescott Island, 9 miles. The shortness of the improved channel had prevented any marked effect on commerce.

During the past fiscal year $11,431.41 had been expended, carrying the improvement to Griffin Bar, about 12 miles above Greatfalls. It is thought that after the subsidence of the present flood a channel of the required depth will be found throughout this distance.

Between Greatfalls and Fort Benton.—Original condition described above. No work has ever been projected for this difficult reach.

Between Fort Benton and Carroll.—The original low-water depth was less than 30 inches. The project contemplates the removal of bowlders, the contraction of the channel on shoals, and dredging. The total expenditures to June 30, 1896, were about $523,500, including cost of before-mentioned work above Greatfalls, resulting in removal of the principal obstructions and improvement of the worst shoals. No work has been done since 1891, navigation having ceased. The works have been damaged by ice and many of the dredged channels have filled up.

At Bismarck Harbor.—The high-water channel above and below Bismarck was of excessive width, and the river was cutting into the right bank a short distance above the bridge and threatening to break through into the Heart River. Under an allotment of $40,000 made by the river and harbor act of August 18, 1894, 7 pile dikes had been built in 1895 to check this erosion. They had fulfilled their purpose, but had been damaged by ice in March, 1896. The damages had been partially repaired in May, 1896, under transfer of $2,328.21 from the balances of the appropriations of 1890 and 1892.

The present project, adopted September 29, 1896, provides for expending the $32,000 allotted from the appropriation of June 3, 1896, in repairing the above dikes, in constructing 2 dikes in continuation of this

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group, and in protecting the left bank just below the bridge. It is a modification of the project adopted July 24, 1896, which provides for an expenditure of $40,000. The present project forms part of a general plan for rectification of the river at and near Bismarck.

To June 30, 1896, there had been expended in this locality $37,619.88. The expenditures during the fiscal year have been $21,428.69. The left bank below the bridge has been protected so far as contemplated by the project. The dikes built in 1895 have been partially repaired, and one dike in continuation of the above group has been begun. The work being incomplete, its results can not yet be stated.

At Pierre and Fort Pierre.—The river here was of excessive width, the steamboat landing at Pierre had silted up, the bank in front of Fort Pierre was cutting badly, and some erosion had occurred on the Pierre front.

Under the allotment of $40,000 made by the river and harbor act of August 18, 1894, 5 dikes were, in 1895, built in front of Fort Pierre, one dike in front of Pierre was completed, and a second dike partly completed, and a dam built closing the chute behind Marion Island. The work formed part of a general scheme for rectifying the river in this vicinity, with a view to restoring the steamboat landing and properly directing the river along the Pierre front. The dikes had checked the erosion in their vicinity. The dam had partly accomplished its purpose, but had been damaged during high water.

The present project, adopted October 2, 1896, provides for expending the allotment of $40,000 from the appropriation of June 3, 1896, in repairing the dam behind Marion Island, completing the unfinished dike at Pierre, revetting the right bank between Bad River (Fort Pierre) and the bluff contact below, and protecting the lower end of Marion Island, so far as funds permit. It is a modification of a project adopted July 24, 1896, which provided for an expenditure of $50,000.

Expenditures at this locality to June 30, 1896, amounted to $39,033.28. During the past fiscal year $24,352.15 was expended, by which the revetment below Bad River has been completed, the dam behind Marion Island has been twice repaired, the unfinished dike at Pierre has been nearly completed, and the shore end of a dike below it constructed. The cutting below Bad River and some of that on the Pierre front has been stopped, and it is thought that the Marion Island Dam will now cause the complete closing of the chute.

At Yankton.—The river in the vicinity of Yankton is of excessive width, and its channel is constantly shifting. Due to changes in its position in the last few years, a wide bar has formed in front of the steamboat landing. No work had been done in this vicinity to June 30, 1896.

A survey of the reach was made in October, 1896.

The present project, adopted March 23, 1897, provides for the expenditure of the allotment of $32,000 from the appropriation of June 3, 1896, in fairing out and protecting the left bank above the site of the proposed bridge, about 3½ miles above Yankton. The work forms part of a general plan for rectification of about 6.5 miles of river in this vicinity, with a view to restoring the steamboat landing and to controlling the river in the vicinity of the bridge. The work has not yet been begun, but preparations for it are in progress. The expenditures during the year have been $502.71.

At Elkpoint.—The left bank at this locality was cutting rapidly, and it was feared by the citizens that the town, although nearly 2 miles

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from the river, was in danger either by direct erosion of the intervening land or by the river cutting into and occupying an old bed which ran by the town.

No work had been done in this vicinity prior to June 30, 1896.

A survey of the reach was made in October and November, 1896. A project for the expenditure of the allotment of $20,000 from the appropriation of June 3, 1896, was submitted February 8, 1897, providing for protection of the left bank so far as the funds permit. It formed part of a general plan for the protection of about 10,100 feet of the left bank lying in front of Elkpoint.

It was decided that the funds should be retained in the Treasury until such additional appropriation is made as will enable the work to be carried on with safety.

The expenditures during the year have been $389.24 (for survey).

At South Sioux City.—The Nebraska bank of the Missouri River in front of South Sioux City had been protected for about 4,000 feet upstream from the lower bridge, and for about 5,400 feet upstream from the upper bridge, by revetments constructed by the owners of the respective bridges. Between these two revetments about 4,270 linear feet of bank was unprotected and was being rapidly eroded. The present project, adopted July 24, 1896, contemplates the expenditure of the funds provided by the river and harbor act of June 3, 1896, in revetting this unprotected bank, in repaving the upper bank for 300 feet farther upstream, and in protecting the head of the work by a short pile dike. The project contemplated the expenditure of $50,000, but as it was believed that the work could be done for the $40,000 allotted, no modification of the project was made. The work forms part of a general plan, described under the next heading, for the improvement of the river in this vicinity.

The total expenditures during the year have been $35,674.36. The work has been completed. Its result has been the stopping of the erosion on the hitherto unprotected portion of the town front.

At Sioux City.—In 1889 a group of 9 dikes had been built at the center of the Sioux City front to check a dangerous erosion. In 1895 2 dikes had been built just above this group and 2 dikes of the group strengthened, and a group of 16 short dikes built near the upper limits of the city to protect the bank there. This latter work formed part of a general plan for the rectification of the river in this vicinity. The present project, adopted June 10, 1897, for the expenditure of the $40,000 allotted from the appropriation of June 3, 1896, provides for protecting the lower portion of the city front (below the Floyd River), which is seriously threatened by recent changes in the position of the channel, for making necessary repairs to existing dikes, and for applying the balance to such work as may be afterwards decided on. The project is a modification of a project adopted February 10, 1897, the change having been rendered necessary by the changes in the channel since the spring flood. A project providing for the expenditure of $50,000, adopted July 24, 1896, had been superseded by the latter.

Under the projects of July 24, 1896, and February 10, 1897, four barges were built, the dikes near the upper limits of the city have been partially repaired, and considerable construction material purchased.

Two surveys of the reach have been made. Preparations are in progress for beginning work under the present project. To June 30, 1896, $186,613.93 had been expended in this locality. The expenditures during the year were $15,637.04, including $8,259.91, freight liabilities of previous year.

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Ice harbors.—Few good natural ice harbors exist on the Upper Missouri. The adopted project provides for the construction of two ice harbors, which have been located at Rock Haven, near Mandan, N. Dak., and on the Big Sioux River (west limit of Sioux City) near its confluence with the Missouri.

The total expenditures to June 30, 1896, were $41,297.74, by which the ice harbor at Rock Haven had been completed, and that on the Big Sioux River nearly completed.

The expenditures during the year have been $1,154.95. The ice harbor on the Big Sioux River, known as the Sioux Ice Harbor, has been completed by the erection of 14 steel mooring posts, and the construction of a fence inclosing the Government land.

River survey.—The project contemplates a detailed survey of the river from Fort Benton, Mont., to Sioux City, based on the secondary triangulation work of the Missouri River Commission, with the publication of maps.

The expenditures on the general river survey above Sioux City, prior to adoption of present project were about $60,000, including $15,000 expended on the survey above Fort Benton. The expenditures on the present project to June 30, 1896, were $138,976.39.

Prior to June 30, 1895, the survey had been completed and mapped, and one series of the maps published. The result has been to furnish accurate maps of the river as it existed at the time of the survey. There have been no expenditures in this connection during the fiscal year. The maps have been stored at the Sioux City office, and the published sheets distributed in accordance with law.

The total expenditures on the Missiouri River between Stubbs Ferry and Sioux City to June 30, 1896, except for snagging, were about $1,254,729.27. In addition about $10,000 was expended on the general river survey above Stubbs Ferry.

It is understood to be the intention of Congress to continue improvements at Bismarck, Pierre (both sides), Yankton, Elkpoint, and Sioux City, and for the purpose of economical work at those localities, an estimate of $675,000 is submitted, with recommendation that the allotment of this amount be left to the discretion of the Secretary of War. This amount is in addition to the estimate ($31,675) submitted for improvement of the river between Great Falls and Stubbs Ferry.

July 1, 1896, balance unexpended		$301,994.97
Pro rata reductions to adjust discrepancy, act June 3, 1896	$50,000.00	
June 30, 1897, amount expended during fiscal year	111,086.24	
		161,086.24
July 1, 1897, balance unexpended		140,908.73
July 1, 1897, outstanding liabilities	18,742.11	
July 1, 1897, amount covered by uncompleted contracts	10,722.36	
		29,464.47
July 1, 1897, balance available		111,444.26

Amount (estimated) required for completion of existing project:	
Great Falls to Stubbs Ferry	114,812.50
Great Falls to Sioux City	Indefinite.
Amount that can be profitably expended in fiscal year ending June 30, 1899	706,675.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix Z 1.)

2. Improving Upper Missouri River by snagging.—In its original condition the "sandy river" between Carroll and Sioux City was greatly obstructed by snags, and to a less extent by loose rocks.

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The original project adopted in 1890 provides for removing the obstructions and the temporary improvement of the worst shoals, at an estimated cost of $50,000 annually. The work, begun in 1891, has been continued in each subsequent year under allotments and appropriations for this purpose. Prior to June 30, 1896, three snag boats had been constructed or purchased and had been operated as funds permitted. The total expenditures to June 30, 1896, were $289,958.95, from allotments, aggregating $193,073.53, from the general appropriations of 1890 and 1892, and from the specific appropriations, aggregating $150,000, of March 3, 1893, August 18, 1894, and June 3, 1896.

The result of the work was to keep the river fairly clear of obstructions, and to temporarily increase the depth over some bad shoals.

During the past fiscal year $27,417.61 was expended. All the boats have been in service, but funds have not permitted their constant operation. The aggregate time was equivalent to three hundred and thirty days for one boat. The results were 956 snags and miscellaneous obstructions removed, 2,732 trees cut on caving banks, and 5,460 miles of river passed over.

Extraordinary repairs on one of the boats are in progress.

July 1, 1896, balance unexpended		$52,953.05
July 30, 1897, amount expended during fiscal year		27,417.61
July 1, 1897, balance unexpended		25,535.44
July 1, 1897, outstanding liabilities	$5,410.00	
July 1, 1897, amount covered by uncompleted contracts	1,920.00	
		7,330.00
July 1, 1897, balance available		18,205.44
Amount (estimated) required for completion of existing project (annually)		50,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix Z 2.)

3. Yellowstone River, Montana and North Dakota.—Originally the channel below Miles City was greatly obstructed by rocks, rapids, bars, and sharp turns, so that navigation was almost impossible at low water above Glendive and quite difficult below. The original project adopted in 1879 contemplated rock removal and contraction works at shoals and a survey of the river. Since 1884 the work had been limited to the portion between Glendive and the mouth. No work was done under the project after 1885, navigation having ceased.

The total expenditures to June 30, 1896, were $122,029.59, including cost of surveys, $19,000. The results were to give a low-water depth of 3 feet or more at all points improved, but the works have since deteriorated and these depths do not now exist at all the improved points. The survey was completed.

The present project adopted October 16, 1896, provides for expenditure of the $10,000 appropriated by act of June 3, 1896, in protecting the right bank in front of Glendive. This work has since been completed. The result has been to stop the erosion of the town front.

July 1, 1896, balance unexpended		$21,720.41
June 30, 1897, amount expended during fiscal year		9,948.69
July 1, 1897, balance unexpended		11,771.72
July 1, 1897, outstanding liabilities		51.31
July 1, 1897, balance available		11,720.41

(See Appendix Z 3.)

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IMPROVEMENT OF CUMBERLAND RIVER, TENNESSEE AND KENTUCKY, AND OF OBION AND FORKED DEER RIVERS, TENNESSEE.

This district was in the charge of Capt. John Biddle, Corps of Engineers. Division Engineers, Col. J. W. Barlow, Corps of Engineers, to May 7, 1897, and Col. Henry M. Robert, Corps of Engineers, since that date.

1. Obion River, Tennessee.—This stream flows wholly within the State of Tennessee. It rises in the western part of that State, and running in a southwesterly direction about 75 miles enters the Mississippi, near Hale Point, about 95 miles above Memphis. The head of navigation is Obion, Tenn.

An examination was made in 1880 and an instrumental survey in 1891. The width of the stream varies from 80 to 200 feet; the height of the banks is from 10 to 18 feet above low water; the depth in the pools is generally over 5 feet at low water, but at the shoals a depth of only 18 inches is frequently found. The channel in its original condition was very crooked and greatly obstructed by heavy drift, snags, and overhanging trees, and practically closed above the mouth of Forked Deer River against the smallest steamboats.

The original project, adopted August 3, 1892, sought to secure at low water a navigable channel of not less than 3 feet depth between Obion, Tenn., and mouth of river, about 68.8 miles, by clearing the channel of snags, drift, and overhanging trees; constructing wing dams at the most obstructive shoals; straightening the very tortuous channel by cutting through several sharp bends, and making the cut-offs sufficiently wide and deep by clearing, grubbing, and excavating; closing the old channel by means of pile and brush dams where necessary, at an estimated cost of $50,000.

The original project and estimate were modified June 1, 1897, for the reason that the amount originally estimated, $50,000, is wholly inadequate to produce the results called for in the project as originally submitted; that is, to obtain 3-foot navigation at low water by means of open-channel work. It is doubtful whether this result can be obtained at all by that method (Report, Chief of Engineers, 1896, p. 1899), and the project is now limited to the work of removal of such obstructions as prevent navigation and to the maintenance of the channel as improved from year to year. The estimated cost of such clearance and maintenance is about $2,500 per year.

Three appropriations, aggregating $21,000, have been made for this improvement. The amount expended to the close of fiscal year ending June 30, 1896, was $14,256.88, which was applied to the removal of surface obstructions, principally drift, and has resulted in opening up the river and obtaining comparatively safe navigation to Obion, Tenn., the upper reaches of the river having been closed for more than fifty years.

During the fiscal year ending June 30, 1897, the amount expended in the channel was $1,540.13. The work consisted of clearing away surface obstructions from Obion to mouth of river, the advantages derived being the removal of a large number of snags and trees carried into the channel by caving banks, principally in the lower reaches of the river.

All the work upon this stream has been carried on by hired labor, the only method economical and advantageous to the Government and the work.

The commerce of the lower river is principally lumber cut by the numerous sawmills on or near the stream. The lumber reaches a mar-

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ket on the Mississippi River, but it is impracticable to get data showing quantities of materials so shipped, as no known records are kept of shipments by river. So far as can be ascertained, the improvements have given material aid to the lumber interests involved.

The commerce of the upper river consists largely of lumber and grain, which is moved between points on the river immediately below Obion, Tenn., and rendered possible only by the improvements made. No reports have been received of the commerce of this stream during the present fiscal year.

July 1, 1896, balance unexpended	$6,743.12
June 30, 1897, amount expended during fiscal year	1,540.13
July 1, 1897, balance unexpended	5,202.99
Amount that can be profitably expended in fiscal year ending June 30, 1899, for maintenance	2,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix A A 1.)

2. Forked Deer River, Tennessee.—This stream lies wholly in the State of Tennessee. The name as here used includes the North and South forks and the main stream formed by their junction.

The North Fork rises in Gibson County and the Middle Fork in Carroll County. These streams unite about 15 miles above Dyersburg, thence, flowing westerly under the name of either North Fork or Middle Fork past that town, joins the South Fork 8½ miles below, thus forming the main stream of the Forked Deer River.

The South Fork rises in McNairy County and flows in a general northwesterly direction for about 250 miles. Jackson, about 148 miles above its junction with the North Fork, is held to be the head of navigation. The stream for some distance below Jackson is very small.

The main stream flows southwesterly and enters into the Obion River 3½ miles above its mouth.

Formerly the Forked Deer River entered the Mississippi through two channels about 18 miles below the present mouth of the Obion River. These outlets, now called "Lost" and "Old" channels, are nearly closed by snags and drifts, but water flows through them during high-water stages in the Mississippi River. About fifty years ago the State of Tennessee cut a canal about three-fourths of a mile long, known as "Tiger Tail," shutting off the former outlet and shortening the Forked Deer River about one-half.

The navigable channel way throughout its entire length, from Dyersburg, Tenn., on the North Fork, and from Jackson, Tenn., on the South Fork, to the Mississippi River was in its original condition greatly obstructed by snags, embedded logs, leaning trees, and large accumulations of drift, the upper sections of the North Fork and South Fork being very crooked and the bends short and numerous. The North Fork below Dyersburg averages 65 feet in width; the South Fork about the same. From the junction of the North and South forks to Key Corner, the last highland on the main river, 11½ miles, the river is from 150 to 200 feet wide, though at several sharp bends it is narrowed to 80 or 100 feet, the channel, however, at these points being generally clear and deep and the banks uniform and unbroken, showing but little erosion. The fall in 20 miles is 6.58 feet. From Key Corner to the Obion River, 9½ miles, with a fall of 15.77 feet, the river flows through the Mississippi bottom lands, shoaling rapidly and being very crooked. The banks are high but alluvial, and therefore subject to heavy erosion. From the mouth of the Forked Deer River to mouth of the Obion

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River, Tennessee, 3½ miles, there is a fall of 4.20 feet, channel width from 60 to 100 feet, but very deep. The bars at the mouths of the Forked Deer and the Obion form the principal obstructions to navigation of this section.

Four examinations and one survey have been made of the main Forked Deer River and its two navigable branches—the North Fork and the South Fork—during the period from 1873 to 1897.

The original project provided for removing surface obstructions so as to give greater ease and safety to navigation, at an estimated cost of $30,750. By act of July 13, 1892, $3,000 was appropriated for "completing improvement;" consequently at the close of the fiscal year ending June 30, 1897, there was then no existing approved general project for improving the Forked Deer River.

The project originally provided for the same class of channel work upon the main stream and its navigable branches.

The amount expended to June 30, 1896, upon the South Fork was $12,500, and upon the North Fork, $12,484.24; total, $24,984.24. These expenditures resulted in putting the North and South forks in fairly good, navigable condition. Upon the South Fork the improvements are reported to have been very advantageous to flatboat navigation. The removal of surface obstructions from the main stream, below the junction of the forks, has aided small steamboats to navigate it for about eight months of each year. The project for "maintenance" of the improvements effected is based upon the act of June 3, 1896, appropriating $1,000 for that purpose. During the fiscal year ending June 30, 1897, $1,001.12 has been expended—$985.36 for "maintenance" and $15.76 for general expenses.

In July, 1896, an examination was made of the channel of the South Fork to ascertain what was necessary to be done for the "maintenance" of the improvements already secured. Active operations were begun on the South Fork October 11, and closed for the season November 24, by reason of exhaustion of available funds. The channel below Chestnut Bluff was pretty thoroughly cleared of surface obstructions. All work was done by hired labor, the only method practicable upon this stream.

The commerce of Forked Deer River and its branches consists principally of lumber and logs, moved between Dyersburg and the Mississippi River. The freight reported for the present fiscal year is 80,258 tons, at an estimated value of $59,500.

The amount estimated for as required for "maintenance" of the improvements effected in the Forked Deer River and its navigable branches is $3,000. (See House Doc. No. 282, Fifty-fourth Congress, second session, and Appendix A A 4 of this report.)

July 1, 1896, balance unexpended	$1,015.76
June 30, 1897, amount expended during fiscal year	1,001.12
July 1, 1897, balance unexpended	14.64
Amount that can be profitably expended in fiscal year ending June 30, 1899, for maintenance. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	3,000.00

(See Appendix A A 2.)

3. The North or Middle Fork of Forked Deer River, Tennessee, from Dyersburg to the Obion River and from thence to the Mississippi River.—This stream is locally known as the North Fork, Forked Deer River, and Obion River, having a total length of 33 miles. The Forked Deer River, including the North Fork, has been previously described (see

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preceding pages), and is here repeated because a separate item of appropriation has been made for the entire stream under the local head of the North Fork, which is only one of the navigable branches of the main river.

A survey was made from Dyersburg, Tenn., to the Mississippi River in 1894, and resurvey in 1897 from Dyersburg to the Obion River. It is held in the reports submitting these surveys that the stream can not be made navigable all the year by means of channel work, and that a permanent low-water navigation is not considered practicable except by means of canalization. A general estimate of $400,000 was made for a slack-water system.

By act of June 3, 1896, $5,000 was appropriated for improving the stream from Dyersburg to the Mississippi River under the general name of North or Middle Fork of Forked Deer River, Tennessee. The approved project for its expenditure is, as provided by said act, to clear the channel of surface obstructions, to reduce bars and shoals at various points so as to deepen the channel and make it navigable for small craft at a 3-foot stage from Dyersburg to the Mississippi River.

No expenditures were made for this specific work during the fiscal year ending June 30, 1896.

During the present fiscal year the sum of $1,052.94 was expended in channel work. Operations were begun September 23 by blasting out sunken logs and trees that formed a bar at mouth of Forked Deer River, and continued up main stream to mouth of South Fork, about 21 miles, removing snags, logs, leaning trees, and surface obstructions generally. The channel in the lower reaches of river was obstructed by a continuous mass of drift, stumps, and logs, requiring the use of explosives to effect a passage. Work was suspended October 11 for the season.

The commerce of this stream, so far as can be ascertained, consists almost wholly of logs, lumber, and timber products, moved in rafts or flatboats.

The benefits derived from the improvements are somewhat indefinite. There is no doubt that new timber lands have been opened up and a certain amount of local navigation developed, mostly rafting logs to mills and carrying off the sawed lumber.

July 1, 1896, balance unexpended	$5,000.00
June 30, 1897, amount expended during fiscal year	1,052.94
July 1, 1897, balance unexpended	3,947.06

(See Appendix A A 2.)

4. Cumberland River, Tennessee and Kentucky.—(*a*) *Below Nashville* (*191 miles*).—This section of the river is usually navigable for six months in each year for all steamboats plying upon it; for boats not drawing over 3 feet from six to eight months; for boats drawing 16 inches or less the whole year, though navigation is practically closed for several months during low water.

An examination was made of this section in 1871, and the channel was found to be of the same general character throughout its entire length, obstructed by rock reefs, bowlders, gravel and sand bars, snags, and overhanging trees.

The project based on this examination provided for the removal of the surface obstructions and deepening the channel by excavation and the building of wing dams. This project was supplemented in 1888, on the recommendation of a Board of Engineer Officers, by the proposed construction of a pile dike with crib superstructure for the improvement

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of the channel at the mouth of the river, from Smithland to the deep waters of the Ohio, for which Congress made provision in river and harbor act of September 19, 1890.

The total amount appropriated under the original project, by acts of 1871 to 1890, inclusive, was $305,000, which has been expended, resulting in lengthening the season of navigation by giving an increased depth at low water and greater security in the passage of obstructions.

A resurvey of the mouth of the river was made in November, 1896, under the provisions of act of June 3, 1896. The report is published in House Doc. No. 283, Fifty-fourth Congress, second session, and also as Appendix A A 5 of this report.

In 1889, under provisions of act of August 11, 1888, a survey was made of the Lower Cumberland River from Nashville to its mouth to ascertain whether necessary to establish locks and dams. On this survey, and estimates submitted therewith, is based the existing project for improving the river below Nashville, consisting of (1) the extension of the lock-and-dam system of the Upper Cumberland to the lower river by the construction of 7 locks and dams, extending from near the mouth of Harpeth River (Lock A) to Big Eddy Shoals (Lock G), the lock chambers to be each 280 feet available length by 52 feet width, the lifts of the lock varying from 8½ to 11½ feet, aggregating about 70 feet; (2) of the improvement of the Kentucky Chute at mouth of river, as recommended by Board of Engineer Officers June 16, 1888 (Report of Chief of Engineers, 1888, p. 1628); (3) of the channel work necessary below Lock G, between Big Eddy Shoals and mouth of river, and (4) snagging and removal of surface obstructions below Nashville. Total estimate of cost of entire improvement, $1,964,500. (Report of Chief of Engineers, 1890, pp. 2151–2161.)

The act of July 13, 1892, appropriated $40,000 for continuing the improvement, including the mouth of the river, and "that $10,000 of this sum, or so much thereof as may be necessary, shall be available for acquiring site and locating lock and dam near the mouth of Harpeth River, Tennessee." This provision forms the initial appropriation for operations under the project or plan as above stated.

Harpeth Shoals are the most formidable obstruction to the navigation of the Lower Cumberland, and to overcome this obstacle the present project has in view that the lock and dam near mouth of Harpeth River, 41½ miles below Nashville, be pressed to completion as rapidly as possible.

Three appropriations, aggregating $150,000, have been made for work under the project for canalization.

The amount expended to June 30, 1896, under present project, was $43,148.94, from which the sites of lock and abutment of Dam A were purchased near the mouth of Harpeth River; temporary buildings erected; lock site, right of way, and bank at lock approaches cleared; cofferdam, 700 feet long, built; riprap protection placed at junction of dam and bank; lock chamber excavated, so far as advisable to be done prior to laying masonry of lock walls; channel cleared of surface obstructions below Nashville.

The appropriation of June 3, 1896, $80,000, is sufficient only to begin the work of construction of Lock A, not to complete it.

During the fiscal year ending June 30, 1897, $19,991.73 was expended, of which $1,302.22 was applied to open-channel work.

At Lock A, 41½ miles below Nashville, active operations were resumed November 24, and continued with a small force to end of fiscal year. The work was mostly of a preparatory character.

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At Lock B, 51 miles below Nashville, at Hollingsworth Landing, the sites were determined and the map is nearly completed. Final action in regard to location is expected to be had early in the present fiscal year.

The availability or adaptability of the improvement for the purposes of navigation and commerce was not increased at the close of the fiscal year by work done under the existing project, and can not be until Lock A is completed and operated. The cost of maintenance of the river in its present condition, as improved by the open channel work of past years, is estimated at about $5,000 per annum, which will necessarily be increased as each lock is completed.

The commerce of the Lower Cumberland River during the fiscal year, so far as could be ascertained, consisted principally of grain, tobacco, sand, lumber, bricks, salt, staves, and general merchandise, aggregating 32,703 tons, having an estimated value of $1,512,637.50.

July 1, 1896, balance unexpended	$106,851.06
June 30, 1897, amount expended during fiscal year	19,991.73
July 1, 1897, balance unexpended	86,859.33
July 1, 1897, outstanding liabilities	3,280.10
July 1, 1897, balance available	83,579.23
Amount (estimated) required for completion of existing project	1,814,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	500,000.00
Amount required for maintenance in fiscal year ending June 30, 1899.	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(*b*) *Above Nashville.—From Nashville to head of Smith Shoals, mouth of Rock Castle River (357 miles).*—This section of the river is usually navigable from Nashville, Tenn., to Point Burnside, Ky., foot of Smith Shoals, for steamboats drawing not more than 3 feet from four to six months of each year; for boats of greater draft from two to three months. The fall is 223 feet, or about 8 inches per mile. From Nashville to Caney Fork River (Carthage, 116 miles), the river is navigable for steamboats of 2½ feet draft from six to eight months, and for those of greater draft four or five months. Steamboats of light draft can ascend to Burkesville, 236 miles above Nashville, for from five to seven months, and larger boats four or five months.

Examinations and surveys were made in 1870, 1874, 1879, and 1880, which formed the basis under which work was done until the adoption of the present project. The character of the navigable channel way and the obstructions in the river above Nashville are of the same general character throughout, consisting of ledges, gravel and sand bars, bowlders, snags, overhanging trees, and rapid currents, and of milldams in the section of the river above the mouth of Jellico Creek. Under the old project, $346,000 had been appropriated and expended above Nashville, in open-channel work, resulting in obtaining an increased depth at the principal obstructions and securing a longer and safer period of navigation.

Instrumental surveys were made in 1882 and 1883, which with accompanying estimates (Report of Chief of Engineers, 1884, p. 1663 et seq.), furnish the basis of the present project for the radical improvement of the Cumberland River.

This project originally provided for the construction of 23 locks and dams between Nashville, Tenn., and Burnside, Ky., and of 7 locks and 2 dams at Smith Shoals, using the river itself as a canal, 1 dam at Mill

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Shoals, and the other at or near Shadowen Shoals, at an estimated cost of $4,077,922. The project stated that the 23 locks between Nashville, Tenn., and Burnside, Ky., "should be about 60 feet wide and 250 feet between miter sills, though perhaps smaller dimensions would answer the purpose" (Report of Chief of Engineers, 1884, p. 1664), and that the dimensions of the 7 locks at Smith Shoals were to be "55 by 140 feet in the chamber." (Report of Chief of Engineers, 1882, p. 1864.) This project was modified by enlarging the dimensions of each lock-chamber to 280 feet length, 52 feet width, and from 10 to 12 feet lift with 4 feet of water on lower and 5 feet on upper miter sill. (Report of Chief of Engineers, 1888, p. 1623.) The project was further modified as to channel depth by increasing the depth of water to 6½ feet, thus providing for a minimum navigation of 6 feet instead of 4 feet. Approved November 29, 1890. Locks Nos. 2, 3, and 4, as constructed, have a uniform depth of 6½ feet on the sills. The project was again modified August 12, 1895, by reducing the number of locks on the Smith Shoals section to six.

The present project, therefore, provides for the complete canalization of the Cumberland River from Nashville, Tenn., to the head of Smith Shoals—mouth of Rock Castle River—by a system of lockage, consisting of 29 locks and dams, if that number be necessary, 23 below Burnside, Ky., and 6 above that point—the Smith Shoals section—with a view to secure a minimum channel depth of 6 feet; locks to be each 280 feet long by 52 feet wide, and having from 10 to 12 feet lift, at an estimated cost, as revised, of $9,000,000. (Report of Chief of Engineers, 1896, pp. 1911, 1916.)

The cost of maintenance of the river in its present condition, as improved by open-channel work of past years, including the necessary annual snagging operations, is estimated to cost about $5,000 per annum, which estimate will necessarily be increased as each lock is completed.

The amount expended to close of fiscal year ending June 30, 1896, was $853,326.74, of which $18,506.76 was expended on account of the Smith Shoals section. This expenditure has been applied under the present project to the examination for, and purchase of, sites for locks and abutments of Dams Nos. 1 to 6; fencing United States lands; clearing sites; erecting temporary buildings; constructing Locks Nos. 1, 2, 3, and 4 and abutment of Dam No. 1; building lock-keeper's house, Lock No. 1; procuring stone, building cofferdams, and excavating and concreting foundation of chamber of Lock No. 5; buying dredge boat and building new hull for same; changing U. S. snag boat *Weitzel* into towboat, refitting her with new powerful machinery, etc.; building the tender *John Phœnix* and towboat *Susette* and six large-decked stone barges for use in work of lock construction; clearing channel of surface obstructions from Nashville, Tenn., to Burnside, Ky.; reducing rock ledges and gravel bars; repairing and extending riprap dams, a few miles below Burnside, Ky., and paying authorized and contingent expenses pertaining to the whole work. The amount expended during the fiscal year ending June 30, 1897, was $78,692.41, of which $859.68 was expended on account of Smith Shoals section. The funds were applied to the purchase of lands for sites for lock and abutment of Dam No. 7, and abutment of Dam No. 22, and to the following specified work: At Lock No. 2, completing masonry of lock walls October 26, 1896; protecting banks by riprapping and paving; at Lock No. 5, preparing foundation for lock; repairing U. S. steamer *Weitzel;* clearing channel of surface obstructions from Cloyds Landing to Nashville.

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Advertisement was made for proposals to supply stone for lock masonry, to be opened March 10, 1897. Only one bid was received, aggregating $238,958.14, which was rejected as excessive. Authority was granted to procure the stone under the law and regulations governing purchases generally.

Under the provisions of the river and harbor act of June 3, 1896, and the sundry civil act of June 4, 1897, continuous contracts were entered into May 4, 1897, for the construction of locks and abutments of Dams Nos. 6 and 7, the consideration aggregating the sum of $346,561.25; the necessary preparatory work was progressing satisfactorily at the close of the fiscal year. Of this sum $260,000 is to be paid from the appropriation made in sundry civil act of June 4, 1897, therefore requiring a further appropriation to carry out the terms of the above specified contracts.

Smith Shoals section.—From 1876 to 1882 the sum of $115,000 was appropriated for the improvement of this obstruction, which has been expended in open-channel work under the old project. The present project forms part of the general project for improving Cumberland River above Nashville, Tenn., and provides for canalization by construction of six locks and dams. The amount expended to June 30, 1896, upon this section was $18,506.76, which was applied to survey of river from Burnside to mouth of Rock Castle River—30 miles—to determine location of lock and abutment sites, preparation of maps, etc. The sites selected for the six locks and abutments have been approved, and authority granted to acquire the lands by voluntary purchase, or by condemnation, if necessary. Abstracts of title to the lands to be acquired have been obtained, and action thereon will be taken as soon as practicable.

Amount expended during fiscal year ending June 30, 1897, $859.68, in payment of authorized contingent expenses.

The availability or adaptability of the improvement for the purposes of navigation and commerce has not been increased by the work done under the existing project, and can not be until a definite section of the river has been canalized and locks put in operation. The present condition of the work by reason of its character and incompleteness is such that it has not at present any appreciable effect upon the object sought to be attained—that is, the opening up of the Upper Cumberland River to navigation—other than that the improved channel already secured has been maintained.

From the conditions on this river no benefit could be derived from the canalization until it be extended at least to mouth of Caney Fork. It is desirable, therefore, to build seven locks and abutments before any of the dams are put in.

The commerce of the Cumberland River above Nashville for the fiscal year ending June 30, 1897, consisted principally of coal, sand, live stock, tobacco, grain, lumber, and general merchandise, aggregating 54,994 tons, at an estimated value of $3,067,675.

By the terms of the act of June 3, 1896, the sum of $600,000 was pledged for the completion of Locks Nos. 5, 6, and 7. Of this amount $350,000 was appropriated by the act of June 4, 1897, leaving $250,000 yet to be provided. This sum will be insufficient to complete the dams for these locks; and as the approved project for the improvement of the river contemplates the construction of 29 locks and dams, it is believed that an additional amount should be appropriated An estimate of $750,000 additional is therefore submitted for the consideration of Congress.

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July 1, 1896, balance unexpended		$141,673.26
Amount appropriated by sundry civil act approved June 4, 1897		350,000.00
		491,673.26
June 30, 1897, amount expended during fiscal year		78,692.41
July 1, 1897, balance unexpended		412,980.85
July 1, 1897, outstanding liabilities	$2,682.93	
July 1, 1897, amount covered by uncompleted contracts	260,000.00	
		262,682.93
July 1, 1897, balance available		150,297.92

Amount (estimated) required for completion of existing project	7,155,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	1,000,000.00
Amount required for maintenance in fiscal year ending June 30, 1899. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	5,000.00

(See Appendix A A 3.)

SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The surveys of the following localities, required by the act of June 3, 1896, were made by the local engineer, Capt. John Biddle, Corps of Engineers, and reports thereon submitted through the division engineer, Col. J. W. Barlow, Corps of Engineers.

1. *Survey of North Fork of Forked Deer River, Tennessee, from Dyersburg to the main stream, and thence to Obion River, with a view of deepening the channel and improving navigation from Dyersburg to the Mississippi River.*—Captain Biddle submitted report of survey January 26, 1897. He does not consider a permanent low-water navigation practicable on these streams, except by means of canalization. He recommends that the improvement of the river between Dyersburg and the mouth be confined to clearing snags, shutting off basins, closing secondary channels, and aiding in the general improvement of navigation. The sum of $3,000 per year would be required to effect this object. The views and recommendations of the local officer are concurred in by the division engineer. The report was transmitted to Congress and printed in House Doc. No. 282, Fifty-fourth Congress, second session. (See also Appendix A A 4.)

2. *Survey of mouth of Cumberland River, Kentucky.*—Captain Biddle submitted report of survey December 23, 1896. He states that the two channels leading from the Cumberland River to the Ohio River accommodate easily all Cumberland River navigation, and probably all that of the Ohio River which is apt to take this route, and that the conditions in the channel are improving. He therefore sees no reason for further improvements or expenditures at this point for the present, except such as are necessary to keep the present works in condition, and perhaps to extend them somewhat if circumstances require. In this connection the local officer states that the sum of $20,000 should be appropriated for maintenance of works at the mouth of the Cumberland River, to be used whenever necessary. The views of the local officer are concurred in by the division engineer. The report was transmitted to Congress and printed in House Doc. No. 283, Fifty-fourth Congress, second session. (See also Appendix A A 5.)

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IMPROVEMENT OF TENNESSEE RIVER AND ITS TRIBUTARIES.

This district was in the charge of Capt. Dan C. Kingman, Corps of Engineers, with Lieut. James F. McIndoe, Corps of Engineers, under his immediate orders, to September 26, 1896. Division Engineers, Col. J. W. Barlow, Corps of Engineers, to May 7, 1897, and Col. Henry M. Robert, Corps of Engineers, since that date.

TENNESSEE RIVER SYSTEM.

The Tennessee River receives its water from seven different States, and the total area drained by it is, in round numbers, 44,000 square miles. It discharges in time of great floods not less than 700,000 cubic feet of water per second, and at its low-water stages its discharge each second is 10,000 cubic feet.

The Tennessee River and its principal tributaries form a system of internal waterways, capable of being navigated by steamboats, more than 1,350 miles in extent. In addition to this, it is still further navigable by rafts and flatboats for a distance of more than 1,050 miles, thus making a system of navigable water of the United States 2,400 miles in extent.

The river is not navigable during the entire year, but the improvements which have already been made are sufficient to demonstrate that the main trunk of the river can be made navigable throughout the year, and that the useful season of navigation can be greatly lengthened on all of the tributaries. The whole system, on account of the hard bottom of the streams and their stable banks and from the fact that they are seldom obstructed by ice, is exceptionally susceptible of improvement.

Notwithstanding the many obstructions which still exist in the river and the difficulties and dangers of navigation, there were 64 different steamboats of an aggregate tonnage of 10,000 tons, and 240 barges of a carrying capacity of 80,000 tons, employed during the year 1896 upon the system. In addition to these a large amount of lumber was transported in rafts, and a considerable amount of material was moved in flatboats, of which no record could be obtained. The statistics actually collected show that there were transported upon the river during the year above mentioned more than 100,000 passengers and nearly 2,000,000 tons of freight valued at $22,000,000.

For the purpose of appropriation and administration the river system has been subdivided as follows:

1. Tennessee River.—(a) Above Chattanooga, Tenn. (188 miles).—This section of the river extends from the junction of the French Broad and Holston rivers to Chattanooga. In its original condition it was obstructed by rock reefs, bowlders, gravel bars, and by snags brought down by freshets. The depth of water on the bars varied from 10 inches to 30 inches at low water, and the current was at some places as great as 6 miles an hour. The river was examined in 1830 by Col. S. H. Long, United States Topographical Engineers, and a project for its improvement was prepared. This project proposed to blast a channel through the reefs, reduce the gravel and sand bars, and to deepen the water on the bars by the construction of wing dams and training walls, thus contracting the waterway so as to secure a safe navigable channel 3 feet deep at average low water. No work, however, was done by the United States under this project until 1869, when an allotment of $35,000 was made for improving this portion of the river.

In 1871 another examination was made between Knoxville and Chat-

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tanooga, with the result of somewhat increasing the estimates of Colonel Long. Work was carried on under this project until 1893, and a partial improvement was effected at 29 of the 43 observations enumerated by Colonel Long in his report of 1830.

The river and harbor act of September 19, 1890, required that a careful and comprehensive survey should be made of this portion of the river and a new project submitted for its improvement. This survey was made under the direction of Col. Henry M. Robert, Corps of Engineers, by Capt. John Biddle, Corps of Engineers, and a report was submitted February 23, 1893, and received Congressional sanction in the river and harbor act of August 18, 1894.

The total amount expended to June 30, 1895, under the original project was $293,255.83.

Since the adoption of the present project to June 30, 1896, $26,502.80 has been expended.

This work has resulted in greatly improving the low-water navigation of the river, and the season of navigation has been materially lengthened.

The commerce on the river has increased and the cost of water transportation has been reduced. The total value of freight carried on this portion of the river during the calendar year ending December 31, 1896, was $2,788,022.20.

During the fiscal year ending June 30, 1897, the following work was done at Caney Creek Shoals:

A channel 200 feet wide and 10,000 feet long was worked over so as to afford a new and better crossing; about 2,800 cubic yards of solid rock reefs was blasted out and removed, and the new channel was indicated by buoys and targets. A low dam 877 feet long was built along the crest of the lower reef in order to prevent the fall of the water in the pool above, due to channel excavation. The longitudinal Dam No. 3 was lengthened 420 feet and a check dam 80 feet long was constructed. A rock and gravel bar at the head of the shoals was partially removed by dredging.

July 1, 1896, balance unexpended	$41,241.37
June 30, 1897, amount expended during fiscal year	19,330.06
July 1, 1897, balance unexpended	21,911.31
July 1, 1897, outstanding liabilities	1,532.19
July 1, 1897, balance available	20,379.12
Amount (estimated) required for completion of existing project	585,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	65,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(*b*) *Below Chattanooga, Tenn. (485 miles).*—The original condition of the river from Chattanooga to Browns Ferry was unfavorable to navigation, the channel being obstructed by rock reefs, bars, bowlders, and projecting rocky points, permitting the passage of vessels from six to nine months annually. From Browns Ferry to Florence it was navigable only at unusually high-water stages, owing to the obstructions known as Big and Little Muscle shoals. Navigation between Florence and Riverton, Ala., was limited to about six months annually, owing to the obstructions known as Colbert and Bee Tree shoals.

The existing project of improvement is as follows:

(1) Removing obstructions by blasting and dredging at Ross Towhead, in "The Suck," and at Bridgeport and Guntersville, Ala.

(2) Building a canal 14.5 miles long, 70 to 120 feet wide, and 6 feet

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deep, to permit navigation past the river obstruction known as Big Muscle Shoals, the canal to have nine locks, each 60 feet wide by 300 feet long, and to cross Shoal Creek by means of an aqueduct 900 feet long and 60 feet wide. Constructing a canal 1½ miles long to enable vessels to avoid the obstruction known as the Elk River Shoals; this canal to have two locks, one at each end.

(3) Constructing at Little Muscle Shoals a canal about 3 miles long and 6 feet deep, with two locks, each 60 feet wide by 300 feet long, and with 5 feet on the miter sills, at an estimated cost of $1,537,762.

(4) Constructing a canal 8 miles long, 150 feet wide, and 7 feet deep, past the Colbert and Bee Tree shoals obstructions, with one guard lock at the upper end and one lock with 25-foot lift at the lower end; these locks to be 80 feet wide and 350 feet long, and with 6 feet on the miter sills, at an estimated cost of $2,500,000.

(5) Protecting Livingston Point, Kentucky, from destruction by revetments of stone and brush carried well down the bank below the water surface, supplemented by pile and stone dikes. This work is necessary to the preservation of the harbor of Paducah, Ky.

(6) Making a survey of the river from Riverton, Ala., to the mouth, and the removal of snags and other obstructions from the channel.

The total amount expended to June 30, 1896, was $4,216,360.80.

This expenditure has resulted in the completion of the Big Muscle Shoals and Elk River Shoals canals and their approaches at a cost of $3,181,726.50, and in the improvement of Little Muscle Shoals by excavation and the construction of wing dams, whereby its navigation was greatly improved. But as the results show that the requisite depth could not be obtained in this manner, the new project for a canal at Little Muscle Shoals was adopted October 29, 1890.

In like manner the Bee Tree and Colbert shoals were temporarily improved and the season of navigation over them materially lengthened by channel work at a cost of $62,243.41. This was before the adoption of the present project for the lateral canal.

The masonry of the lift lock at Colbert Shoals has been completed, and the right of way for the canal has been purchased and paid for.

It has not been possible to advance the work rapidly during the past year, owing to the small size of the last appropriation, but even at the present rate of progress all of the funds will be exhausted before July 1, 1898.

Below Bee Tree Shoals a certain amount of work has been done in the removal of snags and other obstructions.

The total value of the freight carried on the river below Chattanooga during the calendar year 1896 was $17,878,203.50, which is over four times the total amount expended on the improvement of the river in the past seventy years. It is worthy of note, however, that nearly 90 per cent of this commerce is to be found on the river below Bee Tree Shoals, though the valley of this portion of the river is not more productive than that above.

During the fiscal year ending June 30, 1897, the work of channel improvement, mainly by blasting and dredging, has been done at the following places: Bridgeport, Ala., Widows Bar, head of Henrys Island, Beards Reef, Flint River Bar, Sweetwater Bar, Wagon Factory Bar, below bridge at Florence, Nances Reef, and below Riverton, Ala. Below Riverton 9,013 leaning trees were cut and 26 snags removed.

The Livingston Point revetment has been repaired by the addition of about 6,000 tons of riprap, and short levees have been built across the low places on the point to prevent the concentrated flow of water across it.

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The lift lock at Colbert Shoals has been completed so far as the masonry of the lock is concerned. The cost of this work was $412,000, in round numbers. A plan has been prepared by a Board of Officers for the construction of the entrance to the lock from the river.

The survey of the river below Riverton, authorized by act of Congress of August 17, 1894, has been completed, and the work has been plotted, forming 63 charts, copies of which are now being prepared to accompany a special report on this portion of the river. The information gained by the survey has not been fully discussed, but a partial study indicates that there are between 60 and 70 points upon this 226 miles of river where improvement is required. It seems highly probable that all necessary improvement can be secured by dredging, and the purchase of a very powerful dipper dredge with dump scows, at a total cost of about $30,000, will probably be desirable and necessary.

July 1, 1896, balance unexpended		$473,165.23
June 30, 1897, amount expended during fiscal year		221,853.63
July 1, 1897, balance unexpended		251,311.60
July 1, 1897, outstanding liabilities	$14,614.03	
July 1, 1897, amount covered by uncompleted contracts	19,500.00	
		34,114.03
July 1, 1897, balance available		217,197.57

Amount (estimated) required for completion of existing project	5,362,939.81
Amount that can be profitably expended in fiscal year ending June 30, 1899	2,000,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix B B 1.)

2. Operating and care of Muscle Shoals Canal, Tennessee River.—This canal has been maintained in a state of efficiency and readiness for use throughout the entire year. The number of steamboats and barges that used the canal was 193 and the freight carried was 3,880 tons, worth $145,720; the total number of lockages was 1,040.

The canal is 16 miles in length and has eleven locks. It has a railroad nearly 15 miles in length, and a large number of buildings for the occupancy of the employees of the United States and for other purposes. The maintenance of a work of such magnitude, subject to so great exposure and injury as a lateral canal necessarily is, can not be otherwise than expensive. The canal could be operated for the accommodation of ten times as many boats as now use it without greatly increased cost, but it can not be cared for and maintained without considerable expense.

The total cost of operating and care for the fiscal year ending June 30, 1897, was $62,979.55.

In 1895 authority was given for the construction of a dry dock near Lock No. 6 on the Muscle Shoals Canal, for the purpose of providing a place for the repair of the floating plant belonging to the improvement works of the Tennessee River, one-half of the cost of the same to be charged to operating and care of Muscle Shoals Canal and one-half to the general improvement of the river. The dry dock was completed in February, 1897, and since that time has been constantly used in the repair of the Government plant. It is the only dock within a radius of 250 miles, and its use to a limited extent for the repair of private boats would doubtless be of great service to the commercial interests. There is no existing law, however, permitting it to be so used, and I recommend that Congress specially provide that the said dry dock may be used for the examination and repair of vessels for private parties,

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under such regulations and for such compensation as may from time to time be fixed by the Secretary of War.

(See Appendix B B 2.)

3. French Broad and Little Pigeon rivers, Tennessee.—French Broad River.—This river rises in the western slopes of the Blue Ridge Mountains in North Carolina and enters the State of Tennessee at Paint Rock, and after a course of 121 miles in that State unites with the Holston River 4½ miles above Knoxville, thus forming the Tennessee River.

In its original condition the river was obstructed by rock reefs, sand and gravel bars, and also by bowlders, snags, and overhanging trees.

The project for its improvement provides for the removal of all surface obstructions, for the excavation of channels through the reefs and bars, and for the concentration of the water and the regulation of its flow by means of wing dams and training walls, so as to secure a channel depth of 2½ feet at ordinary low water as far as Leadvale, 70 miles from the river mouth.

The amount expended to June 30, 1897, was $67,605.29.

This expenditure resulted in the improvement of navigation below Dandridge, 50 miles, by deepening and clearing the channel, removing the dams constructed for fish traps, constructing wing dams, sills, and training walls, and revetting the banks where necessary. The work in every case, when properly planned, has been singularly successful, and at several points, such as Hanging Rock Shoals, Seven Island Shoals, and Bryant Shoals, which places were formerly almost insurmountable, boats now pass at all stages without difficulty.

The total value of freight carried on the French Broad River during the calendar year 1896 was $1,469,835, which is about twenty-one times the total amount expended on the river since the improvement was begun in 1880.

No work has been done on the French Broad River during the past year. An examination was made and the improvement was found to be generally in a good condition. The appropriations for the tributaries are generally so small that they do not justify the purchase of a sufficient plant to make the improvement in the most economical manner. For this reason it is intended to take the plant belonging to the Upper Tennessee River for about two months during the present summer and to apply the existing appropriation in further work of improvement in pursuance of the project. The entire amount available will be expended before the close of the fiscal year 1898.

Little Pigeon River.—This river is formed by the junction of its east fork and south fork at Sevierville, Tenn., and flows in a northwesterly direction for about 5 miles, where it empties into the French Broad about 32 miles above Knoxville.

In its original condition it was obstructed by rock and gravel shoals and by rapids.

The project provides for the removal of the bar near the mouth of the river and the removal of the shoal below Catlettsburg, so as to permit light-draft steamers to reach this place.

The amount expended to June 30, 1896, was $1,150.39, which resulted in some improvement of the bar below Catlettsburg, about 90 cubic yards of rock having been excavated from the channel and placed in a riprap dam.

It is impracticable to separate the freight carried on the Little Pigeon River from that carried on the French Broad, as the same boats are

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engaged in the trade, and the Little Pigeon practically amounts to an additional landing on the French Broad.

No work has been done during the fiscal year. When the plant belonging to the Upper Tennessee River is sent to the French Broad River, as described above, the work of improving the Little Pigeon will be carried as far as the amount available will permit.

FRENCH BROAD RIVER.

July 1, 1896, balance unexpended	$5,517.44
June 30, 1897, amount expended during fiscal year	122.73
July 1, 1897, balance unexpended	5,394.71
July 1, 1897, outstanding liabilities	131.23
July 1, 1897, balance available	5,263.48
Amount (estimated) required for completion of existing project	77,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

LITTLE PIGEON RIVER.

July 1, 1896, balance unexpended	849.61
July 1, 1897, balance unexpended	849.61
Amount (estimated) required for completion of existing project	8,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	8,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix B B 3.)

4. Clinch River, Tennessee.—This river rises in the Cumberland Mountains in Virginia, and after following a southwesterly course empties into the Tennessee River at Kingston, 104 miles above Chattanooga. About 230 miles of the river lies in the State of Tennessee.

In its original condition the channel was obstructed by rock reefs, sand and gravel bars, bowlders, snags, and overhanging trees.

The present project provides for channel excavations, removing surface obstructions, and the construction of wing dams, so as to secure a safe, navigable channel of 2 feet at ordinary low water from mouth of river to Clinton, about 70 miles, and of 1½ feet from Clinton to Haynes or Walkers Ferry, about 75 miles; but from Haynes to the Tennessee State line, 85 miles, the only work practicable is to remove the loose rock and reduce the rock ledges, thus to assist flatboat navigation during "rain tides."

The amount expended to June 30, 1896, was $37,119.20, which resulted in reducing the reefs, removing snags and overhanging trees, and building several heavy wing and longitudinal dams, thereby securing a passable channel at stages of the river 2 or 3 feet lower than before the improvement was begun.

The total value of freight carried on this river during the calendar year 1896 was $357,783, which is about eight times the tota amount expended on the river since the improvement was begun in 1880.

It is proper to say that before going further with the improvement, it is desirable that a complete survey of the river should be made and a detailed and comprehensive plan, with estimates, be prepared to permit a revision of the project.

No work has been done during the past year. The amount available—a little over $4,000—has been authorized to be expended in

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removing the worst obstructions which interfere with navigation, at stages at which it is now practicable, from Osborn Ford, in Virginia, to the mouth of the river at Kingston, Tenn. A party will be organized early in July which will work over the entire river, removing, as far as practicable, snags, overhanging trees, bowlders in the channel, and reducing some of the worst rock reefs. The total amount available will be expended before the close of the fiscal year 1898.

July 1, 1896, balance unexpended	$4,380.80
June 30, 1897, amount expended during fiscal year	34.00
July 1, 1897, balance unexpended	4,346.80
July 1, 1897, outstanding liabilities	28.84
July 1, 1897, balance available	4,317.96
Amount (estimated) required for completion of existing project	8,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	8,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix B B 4.)

SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The surveys of the following localities, required by the act of June 3, 1896, were made by the local engineer, Capt. Dan C. Kingman, Corps of Engineers, and reports thereon submitted through the division engineer, Col. J. W. Barlow, Corps of Engineers:

1. Survey of mouth of Tennessee River, Kentucky.—Captain Kingman submitted report of survey March 20, 1897. He states that this portion of the river is in good condition, having sufficient depth for all purposes of navigation, and that steamboats can enter and leave it without difficulty. The local officer expresses the opinion that no further appropriation or allotment is necessary at this time for the mouth of the river, and his views are concurred in by the division engineer. The report was transmitted to Congress and printed in House Doc. No. 19, Fifty-fifth Congress, first session. (See also Appendix B B 5.)

2. Survey of Emory River, Tennessee, from its mouth to the town of Harriman.—Captain Kingman submitted report of survey March 18, 1897. Emory River empties into the Clinch River, and the Clinch in turn empties into the Tennessee River at the town of Kingston. The plan of improvement proposed contemplates the construction at Kingston of a lock and a dam, the latter to be provided with four bear-trap sluices, to be placed next to the lock and to serve as the movable portion of the dam. The total cost of the proposed work is estimated at $260,000. The method of improvement thus outlined would afford not only a perfect low-water navigation to Harriman on the Emory, but would at the same time effect an improvement on the Clinch by backing up the water for a probable distance of 20 or 25 miles, and in the opinion of the local officer the river is worthy of improvement in accordance with the plans proposed. The division engineer recommends that the construction of a lock and dam, though a worthy improvement, be deferred until after the contemplated improvement for obtaining constant navigation in the Tennessee River be completed. The views and recommendations of the division engineer are concurred in by the Chief of Engineers. The report was transmitted to Congress and printed in House Doc. No. 22, Fifty-fifth Congress, first session. (See also Appendix B B 6.)

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IMPROVEMENT OF OHIO RIVER AND OF MUSKINGUM RIVER, OHIO.

This district was in the charge of Maj. W. H. Heuer, Corps of Engineers, with Lieut. Mason M. Patrick, Corps of Engineers, under his immediate orders to May 15, 1897. Division Engineer, Col. Henry M. Robert, Corps of Engineers.

1. Ohio River.—The Ohio River from Pittsburg, Pa., to its mouth in the Mississippi, near Cairo, Ill., has a length of about 1,000 miles. Its total drainage area is about 210,000 square miles. The total population of the cities and towns situated immediately upon the banks of the Ohio and its principal tributaries is. in round numbers. 1,800,000. (Census of 1890.)

Original condition.—The first work to improve the navigation of the river was done in 1825. At that time the river was obstructed throughout its entire length by snags, rocks, and gravel and sand bars, and navigation at low stages was exceedingly difficult and dangerous.

Project.—The general project which has been followed since work was first commenced on the river is to secure additional low-water depths at islands and bars by the construction of low dams across chutes, by building dikes where the river is wide and shallow. by dredging, and by the removal of rocks and snags.

A modification of this project for a portion of the upper part of the river has been approved and the radical improvement of this stretch of river undertaken by the construction of a series of locks and movable dams. The first of the series is at Davis Island, 4½ miles below Pittsburg, and has been in successful operation since 1885. At No. 6 the lock is practically completed and work on the dam begun, the land for No. 2 is purchased, and the acquisition of land for Nos. 3, 4, and 5 is in progress; projects for the locks for Nos. 2, 3, and 4 will be submitted at once.

The amount expended up to the close of the fiscal year ending June 30, 1896, was $5,596,822.96.

The work accomplished up to that date has been of great benefit to navigation, but at many localities good results can only be obtained by a large expenditure, and the small amount available yearly for the whole river prevents much desirable work of improvement.

During the fiscal year work was carried on at the following localities: Dam between Davis and Neville islands, Duffs Bar; Phillis Island, Wheeling Creek Bar, Marietta Island, Guyandotte Bar, Craigs Bar, Flint Island, and French Island.

Operations of United States dredges.—The plant owned by the United States worked at various localities along the river, and during the year removed 73,736 cubic yards of material.

Ice piers.—An ice harbor was built at Hartford, W. Va., and one pier added to harbor at Middleport, Ohio.

Harbor lines.—High-water data were obtained at Wheeling and some permanent bench marks established at that place and at Cincinnati. Office work on lines at Pittsburg was continued for part of the year.

Survey, Marietta to Pittsburg.—About 30 miles of field work was completed and platted.

Commerce.—The total amount of freight transported during the calendar year 1896 was 9,914,435 tons; passengers carried, 1,223,296.

In general terms, the object of the work now being done and that projected on the river is to secure, as nearly as may be, uninterrupted navigation during the whole year with a minimum low-water channel depth of 6 feet.

The total amount expended on the improvement of the river for the

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last seventy years is not more than 2½ per cent of the value of the commerce carried on the river in a single year.

The work heretofore done has undoubtedly been of the greatest utility in lessening the danger and difficulty of navigation and as a safeguard to commerce, but the capacity of the upper river can only be fully developed by a continuation of the system of movable dams begun below Pittsburg.

July 1, 1896, balance unexpended		$406,219.08
June 30, 1897, amount expended during fiscal year		109,809.36
July 1, 1897, balance unexpended		296,409.72
July 1, 1897, outstanding liabilities	$12,651.40	
July 1, 1897, amount covered by uncompleted contracts	52,734.25	
		65,385.65
July 1, 1897, balance available		231,024.07
Amount that can be profitably expended in fiscal year ending June 30, 1899. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		1,000,000.00

(See Appendix C C 1.)

2. Operating snag boat on the Ohio River.—The condition of the channel way of the Ohio, the necessity for continuous snag-boat work, and the benefits accruing therefrom to river commerce are plainly shown by the yearly reports of obstructions removed, which, if permitted to remain, would make navigation highly dangerous at ordinary stages and hazardous at any time.

The project for removing obstructions by a properly equipped snag boat was put in operation in 1876, when the boat was completed at a cost of $125,125.24, the expense of operating being borne by appropriations for improving the Ohio River until 1890, when the river and harbor act provided $25,000 yearly for this purpose; by the act of June 3, 1896, the yearly appropriation was increased to $50,000.

The amount expended on this work up to the close of the fiscal year ending June 30, 1896, was $136,426.49.

As far as practicable, removal of obstructions is carried on whenever the stage of water will permit, except in the months when the safety of the boat would be endangered by ice; this work, in connection with the occasional hire of boats when the snag boat is not available, maintains a channel as nearly unobstructed as possible, the chief object in view being to remove wrecks as soon as practicable after the limit of time permitted by law.

The amount expended during the year was $30,641.42.

(See Appendix C C 2.)

3. Operating and care of Davis Island Dam, Ohio River, near Pittsburg, Pa.—This dam is the first of the series for the improvement of the upper portion of the river, and it has been in successful operation since 1885. During the year the dam was raised five times and lowered four times, and was up in all eighty-six days. The wooden lock gates, after a service of twelve years, were replaced by steel gates, with some changes for improvement, and the gate tracks renewed. There was no interference with navigation, and the work has been of great benefit to commerce. The cost of operating and care of the dam during the fiscal year ending June 30, 1897, was $36,014.87.

(See Appendix C C 3.)

4. Movable Dams Nos. 2, 3, 4, 5, and 6 in the Ohio River.—For 50 miles or more below Pittsburg the narrow channel of the Ohio River is so greatly obstructed by islands and shoals that navigation for ordinary vessels is much interrupted and only possible for the numerous coal

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fleets of this section in flood stages. The movable dam at Davis Island (completed in 1885) has greatly relieved these conditions near Pittsburg, but it is evident that the only method of securing the desired results is by a continuation of this system.

The construction of Dam No. 6, now building, was ordered by the river and harbor act of September 19, 1890, without previous report or estimate. It is assumed that Congress adopted the report of a Board of Engineers dated November 27, 1888, in which the cost was estimated at $900,000. The special projects were approved as follows: Preliminary, September 27, 1890; lock, June 16, 1892, at an estimated cost of $305,718.75; Chanoine dam across navigable pass, June 10, 1896; contract price, $90,923.89.

The amount expended up to the close of the fiscal year ending June 30, 1896, was $425,043.22.

The lock is now practically completed except the gates and operating machinery; work on the Chanoine dam under contract was begun in June, 1897. The act of June 4, 1897, appropriated $300,000 to complete Movable Dam No. 6.

The construction of Dams Nos. 2, 3, 4, and 5 was provided for by the river and harbor act of June 3, 1896, which appropriated funds for the purchase of the sites "in accordance with the project submitted February 3, 1896." (Annual Report, 1896, part 4, p. 2120.) In this project the estimated cost of the dams is placed at $750,000 each.

Further provision was made in the act of June 3, 1896, for the construction of the dams by the continuous-contract system to an amount not exceeding $1,990,000, being $1,000,000 less than their estimated cost. The act of June 4, 1897, appropriates $400,000 for work on Dams Nos. 2, 3, and 4, and permits contracts to be let for work on Dams Nos. 2, 3, 4, and 5, within the limit above given, the restriction as to limit of cost being removed. This act also provides for annual allotments of 25 per cent of the whole amount authorized to be expended, that is, of $497,500 per year, to which, in accordance with the provisions of section 5 of the act of June 3, 1896, is to be added for the year ending June 30, 1899, $97,500, the allotment for the year ending June 30, 1898, being but $400,000.

The amount expended on Dams Nos. 2, 3, 4, and 5, up to the close of the fiscal year ending June 30, 1896, was $344.90.

Legal proceedings and negotiations are in progress for acquiring all the land needed except that for No. 2, which has been purchased.

Commercial statistics are appended to the report for improving Ohio River.

July 1, 1896, balance unexpended		$204,611.88
Amount appropriated by sundry civil act approved June 4, 1897		700,000.00
		904,611.88
June 30, 1897, amount expended during fiscal year		71,791.51
July 1, 1897, balance unexpended		832,820.37
July 1, 1897, outstanding liabilities	$4,684.45	
July 1, 1897, amount covered by uncompleted contracts	86,980.04	
		91,664.49
July 1, 1897, balance available		741,155.88
Amount (estimated) required for completion of existing project		2,570,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899, continuing construction of Dams 2, 3, 4, and 5		595,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix O O 4.)

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5. Muskingum River, Ohio.—Many repairs and some reconstruction work was necessary when the United States assumed charge of the slack-water navigation on the Muskingum River in 1887. This report is limited to work carried on under an appropriation of $102,000 by act of August 11, 1888, for the construction of a lock at Taylorsville and the reconstruction of the lock at Zanesville, Ohio. This latter work was indefinitely postponed, and Congress diverted to other purposes the money originally appropriated for it.

The amount expended up to the close of the fiscal year ending June 30, 1896, was $94,247.99. New middle gates for the lock at Marietta, Ohio, were put in place during the year. The gates were designed for use when one-half of the lock is sufficient for passing craft; since their completion lockings of the ordinary commerce at this place have been much more rapid.

July 1, 1896, balance unexpended	$7,752.01
June 30, 1897, amount expended during fiscal year	2,131.58
July 1, 1897, balance unexpended	5,620.43
July 1, 1897, outstanding liabilities	2.25
July 1, 1897, balance available	5,618.18

(See Appendix C C 5.)

6. Operating and care of locks and dams on Muskingum River, Ohio.—As originally improved by the State of Ohio, 11 dams and 12 locks were built on the 91 miles of river from its mouth in the Ohio at Marietta to Dresden, where connection was made with the Ohio Canal, which carried the slack-water navigation to Lake Erie at Cleveland. The lock and dam above Zanesville is now in a state of ruin, but the 75 miles of slack water between Zanesville and the Ohio River has been maintained. The locks and dams on this part of the river passed into the hands of the United States in 1887. All the works were in bad repair, and much reconstruction was unavoidable.

The amount expended up to the close of the fiscal year ending June 30, 1896, was $1,135,570.39, and all the locks and dams were put in fair order and were available for navigation.

The amount expended during the fiscal year ending June 30, 1897, was $37,769.27. Repairs were made to the buildings, steamers, and plant, and at all locks and dams where necessary. The only interruption to navigation on account of the locks or dams was at Marietta where failure of the lock floor suspended lockages for 29 days. The river was closed by ice 14 days.

The United States dredge and a towboat were usefully employed during the year in making and maintaining good navigable depth and width in the channels.

The total commerce transported on the river during the calendar year 1896 was 59,597 tons of freight, valued approximately at $2,302,519; passengers carried, 42,470. Whenever warranted all repair and reconstruction is done with a view to permanence, thereby reducing the cost of future maintenance to a minimum, but as many of the structures are old, an exact statement can not be made in advance of the cost of keeping them in serviceable condition. Probably the yearly expense of operating and care of the locks and dams will not exceed 1 per cent of the value of the commerce transported.

(See Appendix C C 6.)

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EXAMINATION MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The act of June 3, 1896, directed that a survey be made of the *Ohio River from Marietta to its mouth.* The very limited amount provided by Congress for making the surveys authorized by the act did not warrant the allotment to this item of a sum sufficient to pay the expenses of a proper survey of the river between the points named; and, with a view of executing as far as practicable the wishes and intentions of Congress, the Secretary of War decided that this item of the act should be treated as a preliminary examination, and that a report be prepared giving an estimate of the cost of the survey desired. The local engineer, Maj. W. H. Heuer, Corps of Engineers, submitted report of examination November 27, 1896, through the division engineer, Col. Henry M. Robert, Corps of Engineers. A survey of the Ohio River from Marietta to its mouth is estimated to cost $119,250. It is the opinion of the local officer that this portion of the river is worthy of improvement, and that, in view of the facts set forth in his report, no detailed survey of the entire length of river below Marietta is at present necessary or desirable. His views are concurred in by the division engineer and by the Chief of Engineers. The report was transmitted to Congress and printed in House Doc. No. 125, Fifty-fourth Congress, second session. (See also Appendix C C 8.)

IMPROVEMENT OF MONONGAHELA AND ALLEGHENY RIVERS, WEST VIRGINIA AND PENNSYLVANIA.

This district was in the charge of Maj. R. L. Hoxie, Corps of Engineers, to April 10, 1897, and of Maj. Chas. F. Powell, Corps of Engineers, since that date. Division Engineer, Col. Henry M. Robert, Corps of Engineers.

1. Monongahela River, West Virginia and Pennsylvania.—The seven lower locks and dams on the Monongahela River belonged to the Monongahela Navigation Company; they create slack water from near the mouth of the river to Dunkard Creek, a distance of 88 miles. Their construction preceded any improvement by the United States, and the original condition of this river above these works was that of a natural stream of insignificant volume in its summer stages, but with navigable flood stages of short duration as far up as Fairmont, W. Va. The originally adopted project for the improvement of this river was the construction of two locks and dams to continue slack water to Morgantown, W. Va., a further distance of 14 miles. This improvement was completed in 1889. The river has an annual commerce of about 4,500,000 tons, originating principally below Lock No. 6. The completion of the improvement to Fairmont, W. Va., is needed to develop the additional commerce expected to justify the expenditure for this purpose.

Locks and Dams Nos. 10, 11, 12, 13, 14, and 15.—By the river and harbor act of July 13, 1892, the sum of $25,000 was appropriated for beginning work on Lock and Dam No. 10. The river and harbor act of August 18, 1894, makes a further appropriation of $20,000, and the river and harbor act of June 3, 1896, appropriates $30,000, making an aggregate of $75,000 for the extension of this improvement. The aggregate appropriation was not sufficient to justify placing this work under contract; but the act of June 3, 1896, authorizes the Secretary of War, in his dis-

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cretion, to enter into contract for the completion of this improvement at a cost not to exceed $1,200,000, to be paid for as appropriations may from time to time be made by law. The language of the act is as follows:

Improving the upper Monongahela River, West Virginia: Continuing improvements, thirty thousand dollars, ten thousand dollars of which may be used for the location and purchase of sites for the dams within said improvement; and the Secretary of War may place the construction of the six dams heretofore recommended and reported by the United States engineers on the Monongahela River, in the State of West Virginia, under contract at a sum not exceeding one million two hundred thousand dollars, to be paid for as appropriations may from time to time be made by law.

The amount expended upon the completed project and upon surveys and examinations for extension of the project to the close of the year ending June 30, 1896, is $441,553.76.

A site for Lock and Dam No. 10 had been previously selected. During the past fiscal year levels were run from Lock No. 9 to Fairmont, duplicated as far as Hoult's, elevations adopted, and benches established. Examinations and surveys were made for sites for locks, dams, and abutments needed therefor as follows: No. 11, at Morgan's mill; No. 12, at Jimmies Ripple; No. 13, at Trippetts Ripple; No. 14, at Rivesville, and No. 15, about 1 mile above Rivesville. A general project for the improvement was prepared; the work advertised for bids under the continuing-contract system, and the contract awarded. The lock lifts for overcoming the fall of 64 feet from Fairmont to Pool No. 9 are to be 10 and 12 feet. The locks and dams will be made of concrete. The useful capacity of the lock-chambers will be 56 by 177 feet by 7 feet depths on the lower sills, at pool levels, and 8 feet on the upper sills at same.

Two thousand yards of material was dredged from the shoal at Smithfield Street Bridge, Pittsburg.

The officer in local charge calls attention to the desirability of marking the harbor lines heretofore established in Pittsburg Harbor, and in establishing a close supervision to prevent unlawful dumping, and providing for a limited amount of dredging in the harbor, which work is estimated to cost $10,000 annually.

A brief history of the Monongahela River and its navigation works, of the steps leading to the acquisition of the works by the United States, and a preliminary report upon necessary enlargements and other improvements, with approximate estimates of cost, are printed in Appendix D D 5 of this report.

July 1, 1896, balance unexpended	$70,346.24
Amount appropriated by sundry civil act approved June 4, 1897	350,000 00
	420,346.24
June 30, 1897, amount expended during fiscal year	1,135.19
July 1, 1897, balance unexpended	419,211 05
July 1, 1897, outstanding liabilities	4,447.37
July 1, 1897, balance available	414,763.68
Amount (estimated) required for completion of existing project	775,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	387,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix D D 1.)

2. Operating and care of Locks and Dams Nos. 8 and 9, Monongahela River.—The locks were operated during the past fiscal year, except

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when the walls were flooded by high water from July 22 to August 3 and from February 22 to 25, and except when navigation was suspended by ice from January 24 to February 9. One thousand five hundred and sixty-four lockages for passing crafts were made at Lock No. 8 and 1,026 at Lock No. 9.

Extensive repairs were made to Dam No. 8, on account of damages caused by heavy floods. Minor repairs to the works were made and some dredging done.

The cost of operating and care of the locks and dams during the past fiscal year was $24,925.87.

(See Appendix D D 2.)

3. Purchase of Lock and Dam No. 7, Monongahela River.—The river and harbor act of August 11, 1888, made provision for the acquisition by the United States, by purchase or condemnation, of this lock and dam from the Monongahela Navigation Company. Condemnation proceedings for this purpose were instituted. The case was heard in the circuit court of the United States for the western district of Pennsylvania in November, 1890, and the value of the work was fixed at $209,000, exclusive of the value of the franchise. The navigation company took an appeal to the Supreme Court of the United States, where the case was argued at the October term, 1892. The judgment of the circuit court was reversed and case remanded, with instructions to grant a new trial.

No steps were taken during the year for the separate purchase of this lock and dam, as the river and harbor act of 1896 provided for the purchase of all the property and appurtenances of the Monongahela Navigation Company, which, since the close of the year, have been acquired by the United States.

July 1, 1896, balance unexpended	$161,831.77
July 1, 1897, balance unexpended	161,831.77

(See Appendix D D 3.)

4. Purchase of Lock and Dam No. 6, Monongahela River.—An appropriation of $162,000 was made by river and harbor act of September 19, 1890, for acquisition of this structure from the Monongahela Navigation Company, and one of $5,000 for costs of condemnation, after title to Lock and Dam No. 7 shall have been acquired by the United States. No steps were taken during the year for the separate purchase of this lock and dam, as the river and harbor act of 1896 provided for the purchase of all the property and appurtenances of the Monongahela Navigation Company, which, since the close of the year, have been acquired by the United States.

July 1, 1896, balance unexpended	$167,000.00
July 1, 1897, balance unexpended	167,000.00

(See Appendix D D 4.)

5. Condemnation of all the property and appurtenances of the Monongahela Navigation Company.—A provision of the river and harbor act of June 3, 1896, reads as follows:

Improving the Monongahela River, Pennsylvania: The Secretary of War is hereby authorized and directed to institute and carry to completion proceedings for the condemnation of all the property and its appurtenances of the Monongahela Navigation Company, a corporation of Pennsylvania, said condemnation proceedings to be as prescribed and regulated by the provisions of the general railroad law of Pennsylvania approved February nineteenth, eighteen hundred and forty-nine, and its supplements, except that the United States shall not be required to give any bond, and except that jurisdiction of said proceedings is hereby given to the circuit court of the United States for the western district of Pennsylvania, with right of

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appeal by either party to the Supreme Court of the United States. And the sum of five thousand dollars, or so much thereof as may be necessary, is hereby appropriated, out of any moneys in the Treasury not otherwise appropriated, to pay the necessary costs of said proceedings; and upon final judgment being entered therein, the Secretary of War, if in his opinion the judgment is reasonable, is hereby authorized and directed to draw his warrant on the Treasury for the amount of said judgment and costs, and said amount for the payment thereof is hereby appropriated out of any moneys in the Treasury not otherwise appropriated. And when said property and its appurtenances shall have been acquired by the United States, whether by purchase or condemnation, the Secretary of War shall take charge thereof and the same shall thereafter be subject to the provisions of section four of an Act entitled "An Act making appropriations for the construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes," approved July fifth, eighteen hundred and eighty-four.

During the last fiscal year condemnation proceedings in accordance with this authority were had, and award was made of $3,761,615.46 for the condemnation and appropriation of all the property and franchises of the company.

Since the end of the year, and on July 7, final judgment was entered by the court; $3,601,615.46 paid to the navigation company, and the property transferred to the United States. The balance of the amount of the award, $160,000, is retained by the United States as security for the cancellation of certain outstanding bonds issued by the company.

In the case of the separate condemnation of Lock and Dam No. 7, the United States Supreme Court decided, upon appeal by the Navigation Company, that the value of the franchise must be considered in the making of the award.

The property comprises 7 locks and dams and appurtenances. Locks Nos. 1, 2, 3, and 4 are double locks; Nos. 5, 6, and 7 are single locks.

July, 1, 1896, balance unexpended	$5,000.00
June 30, 1897, amount expended during fiscal year	.22
July 1, 1897, balance unexpended	4,999.78

(See Appendix D D 5.)

6. Allegheny River, Pennsylvania.—In its original condition the Allegheny River, having a hard gravel and sand bottom, with an average slope for a distance of more than 123 miles between its mouth and French Creek at Franklin, Pa., of 2.15 feet per mile, and of 3.4 feet per mile over 132 miles between Franklin and Olean, N. Y., was obstructed by numerous large bowlders, which reduced the low-water navigable depth as much as 2 feet on various ripples, and made navigation over them extremely hazardous at ordinary stages. The river also embraced several wide-spreading shoals, giving an available navigable depth at low water of less than 6 inches. The originally adopted plan of improvement of the river, which has not been materially changed since its inception, contemplates the removal of bowlders, snags, and other obstructions from the channel, and the construction of low dams to close duplicate channels, and of dikes to confine the waterway on extensive shoals. There had been expended under this project from the date of the first appropriation, in 1879, up to the close of the fiscal year ending June 30, 1896, the sum of $210,305.71, about two-thirds of which had been devoted to the removal of new rock obstructions washed out from the banks, brought down by the rapid tributaries, or moved along the river bed by the action of freshets and ice; the latter is a powerful agent in modifying the river bed. The result has been a marked improvement, furnishing a least depth of 1.4 feet over the shallowest bars at low water, with ample width of channel and a consequent lengthening of the period of navigation, enabling

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the lighter craft to enjoy practically continuous navigation over 150 miles of the stream.

During the last fiscal year 1,373 cubic yards of bowlders and 43 snags were removed from the channel, and small repairs made to the contraction works at Hickory, Tionesta, Redbank, and Cowanshannock, thereby maintaining the improved channel.

July 1, 1896, balance unexpended	$19,694.29
June 30, 1897, amount expended during fiscal year	7,928.16
July 1, 1897, balance unexpended	11,766.13
July 1, 1897, balance available	11,766.13
Amount that can be profitably expended in fiscal year ending June 30, 1899 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	25,000.00

(See Appendix D D 6.)

7. Construction of locks and dams at Herr Island, above the head of Six Mile Island, and at Springdale, Allegheny River.—The originally adopted project provided for the Herr Island Lock and Dam and contemplated that the dam should be a fixed one, but in compliance with a request of the authorities of Pittsburg and Allegheny the plan was changed to give a movable dam, and to satisfy riparian owners the site of the lock was changed so that a waterway for landings 55 feet in width is left between the lock and the river bank. The site of the Herr Island works is in Pittsburg Harbor, formed by the pool of the Davis Island Dam of the Ohio River 6.3 miles below, which gives a navigable depth in the Allegheny River channel of 8 to 9 feet as far as Garrison Ripple, immediately above the Herr Island Dam and about 2 miles above the mouth of the river. The completion of the original project will extend Pittsburg Harbor 4.5 miles farther upstream and begin a system of slack water upon the Allegheny River. The Herr Island Lock is under construction. This is a concrete lock of an available capacity of chamber of 55 feet by 286 feet 2 inches, with a least depth of water over the sills of 8 feet at pool level, and having a 7-foot lift. The lock and miter walls rest on concrete foundations, which were started from the bottom of a dredged pit 30 feet below the pool of the Davis Island Dam in the Ohio River.

At the beginning of the year the foundation walls had been built to a height of 22 feet below the Davis Island pool, a 2-foot concrete floor laid at the bottom of the pit over the chamber area, and a gravel filling made on the floor and against the sides of the pit outside of the foundation walls to 11 feet below pool level.

During the last fiscal year the lock and head walls were completed and the foundations of the miter walls were partly laid; 6,095 cubic yards of concrete and 176 cubic yards of cut stone were used therefor.

The act of June 3, 1896, provided—

For continuing construction of lock and dam at Herr Island, Allegheny River, under existing project, and commencing construction of two additional locks and dams on said river, one above the head of Six Mile Island and the other at Springdale, according to report submitted January 22d, 1896, $50,000: *Provided*, That contracts may be entered into by the Secretary of War for such materials and work as may be necessary to complete the projects of improvement, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate eight hundred and ninety-four thousand five hundred dollars, exclusive of the amount herein and heretofore appropriated.

During the year a general project for the new constructions was prepared and approved; negotiations made for the lands required for sites

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for locks and abutments of dams; plans and specifications drawn; the work advertised for bids, and contract entered into. Part of the needed lands has been acquired by the United States, and it is expected that active operations of construction will be commenced shortly. These new locks and dams will extend slack water, having 6 feet least channel depth from the Herr Island pool 17 miles, or to Natrona. The dams are to be made of timber and the locks of concrete. The lifts of the locks will be 11 and 12 feet, and the depths of water on the lower and upper sills 7 and 8 feet, respectively, at pool levels. The useful dimensions of the lock-chamber are to be 56 by 289.5 feet.

There had been expended upon the whole project up to June 30, 1896, the sum of $165,988.89, of which $32,689.25 was for cost of land.

July 1, 1896, balance unexpended	$71,511.11
Amount appropriated by sundry civil act approved June 4, 1897	350,000.00
	421,511.11
June 30, 1897, amount expended during fiscal year	55,997.09
July 1, 1897, balance unexpended	365,514.02
July 1, 1897, outstanding liabilities	4,484.41
July 1, 1897, balance available	361,029.61
Amount (estimated) required for completion of existing project	544,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	450,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix D D 7.)

IMPROVEMENT OF FALLS OF OHIO RIVER; OF WABASH RIVER, INDIANA AND ILLINOIS; OF WHITE RIVER, INDIANA, AND OF CERTAIN RIVERS IN KENTUCKY.

This district was in the charge of Capt. J. G. Warren, Corps of Engineers. Division Engineer, Col. Henry M. Robert, Corps of Engineers.

1. Falls of the Ohio River at Louisville, Ky.—This work is located at the easterly end of the Louisville and Portland Canal, where the canal formerly had a width of about 100 feet, a space insufficient for arranging or making up tows preparatory to their entering or leaving the canal.

The original project was adopted in 1883, slightly modified in 1885, and revised January 28, 1890, by a Board of Engineer Officers convened for that purpose. The existing project provides for widening the canal on its northerly side, from a point 725 feet below Fourteenth Street Railroad Bridge, where the width of the canal is abruptly increased from 90 to 210 feet. This latter width is gradually increased, through a distance of nearly 2,800 feet, to 325 feet at the head of the canal proper, where the enlargement is expanded into a capacious basin 1,200 feet wide and practically parallel to the Kentucky shore.

Exclusive of the sum expended for enlarging the basin at the head of the new locks, $133,000, the amount expended under the projects hereinbefore outlined, to June 30, 1896, was $645,382.19, of which amount $351,627.31 was expended under the revised project of 1890.

With the exception of a small portion at high water, the improvement is not yet available for the purposes of commerce, on account of its incomplete state.

The sundry civil act of June 4, 1897, contains the following item:

Improving Falls of Ohio River at Louisville, Kentucky: For continuing improvement, including Indiana Chute Falls, three hundred and fifty thousand dollars: *Provided*, That the Secretary of War may carry to completion the present project of

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improving the Falls of the Ohio River and Indiana Chute Falls, Ohio River, by contract, as provided in the "Act making appropriations for the construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes," which became a law June third, eighteen hundred and ninety-six; or the necessary materials may be purchased and the work done otherwise than by contract, in his discretion, if more economical and advantageous to the United States.

The items of the following statement, together with the items contained in a similar statement given in report concerning Indiana Chute, Falls of the Ohio River, and the item of $350,000 in the sundry civil act of June 4, 1897, are combined in the money statement which follows that report.

No field work was in progress until June 12, 1897, when a small force was set to work repairing the guiding dikes and dams.

July 1, 1896, balance unexpended	$11,617.81
June 30, 1897, expended during fiscal year	2,729.04
July 1, 1897, balance unexpended	8,888.77
July 1, 1897, outstanding liabilities	551.02
July 1, 1897, balance available	8,337.75
Amount (estimated) required for completion of existing project	130,008.89

Indiana Chute, Falls of the Ohio River.—This main channel of the river over the Falls of the Ohio was originally very crooked, with irregular rock projecting from sides and bottom, and was only safe for navigation during high stages of water. Previous to January 31, 1890, much work had been done under annual expenditure projects, the funds being derived from allotments from appropriations for improving Ohio River. The project approved January 31, 1890, provides for specific improvements within certain limits by rock excavation and the construction of dikes and dams, so as to render this chute available for descending traffic when the river is at or above a stage of 8 feet, upper canal gauge. The estimated cost was $138,610.97, but a revision of the estimate during 1896 places the total cost at $213,299.68, or amount necessary for completion, June 30, 1896, $111,938.71.

The total expenditures to June 30, 1896, were $218,398.48, of which $116,070.30 was expended previous to the adoption of the present project.

The work done thus far has materially improved the navigability of the chute when the river reaches a stage of 10 feet, upper canal gauge.

No work other than care of property and office work was in progress during the year.

A statement of the amount and character of commerce involved in the improvements may be seen by reference to the statistics accompanying the report for the Louisville and Portland Canal.

Following is a statement of balances, etc., combined with those in a similar statement in report for "Falls of the Ohio River at Louisville, Ky.," to make the items in the money statement given below.

July 1, 1896, balance unexpended	$1,601.52
June 30, 1897, amount expended during fiscal year	1,254.13
July 1, 1897, balance unexpended	347.39
July 1, 1897, outstanding liabilities	114.96
July 1, 1897, balance available	232.43
Amount (estimated) required for completion of project	111,938.71

By the provisions of the act of June 3, 1896, the sum of $517,250 was pledged for the work of improving the Falls of the Ohio River, includ-

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ing Indiana Chute Falls. Of this amount $350,000 was appropriated by the act of June 4, 1897, leaving $167,250 yet to be provided. In addition to this latter sum it has been found that $74,697.60 will be required to complete the work in such a manner as to fully satisfy the requirements of commerce and navigation. Estimates for these two amounts, making a total of $241,947.60, are submitted for the consideration of Congress.

July 1, 1896, balance unexpended		$13,219.33
Amount appropriated by sundry civil act approved June 4, 1897		350,000.00
		363,219 33
June 30, 1897, amount expended during fiscal year		3,983.17
July 1, 1897, balance unexpended		359,236.16
July 1, 1897, outstanding liabilities		665.98
July 1, 1897, balance available		358,570.18
Amount (estimated) required for completion of existing project		241,947.60
Amount that can be profitably expended in fiscal year ending June 30, 1899		241,947.60
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix E E 1.)

2. Operating and care of Louisville and Portland Canal, Kentucky.—The present work is the outgrowth of the construction of the canal by a private corporation and its transfer to the United States by authority of Congress in 1874. The canal is about 2 miles long and 90 feet wide; there are two new masonry locks in flight, the chambers of each being 350 feet long and 80 feet wide.

The annual estimates and projects have provided for the operation and maintenance of the canal in good navigable condition, together with such special work as may from time to time be found necessary to make it sufficient to meet the demands of navigation and commerce.

Expenditures from July 1, 1880, when tolls were abolished and the canal became a direct charge on the Treasury, to June 30, 1897, amounted to $1,158,180.13.

The canal is available to commerce at all stages of water less than 12.7 feet, upper gauge, and serves its purpose by permitting free navigation around the falls of the Ohio River at stages of water when the passage can not be made by the open river channel.

Expenditures during the fiscal year ending June 30, 1897, were, besides those for ordinary operating expenses, for repairing old and dilapidated rubble wall, north side of canal with wall of Ashlar stone, laid in cement; retaining wall in front of unprotected bank; completing new upper and lower gates; for automatic gates, old locks; and for work and material for completing retaining wall of dry dock.

The total of expenditures for all purposes during the year was $93,026.80, including outstanding liabilities June 30, 1897.

The amount and character of the very large commerce interested is given in Appendix E E 2 of this report.

The total quantity of commerce for the year was 1,085,805¼ tons.

(See Appendix E E 2.)

3. Wabash River, Indiana and Illinois.—In its original condition this river was badly obstructed with shoal bars, accumulations of snags, rock reefs, and numerous secondary channels or cut-offs, which lessened the flow of water through the main channel. There could be no navigation except at high stages of water.

The original project is that submitted by Maj. G. Weitzel in 1872,

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providing for special improvement at twelve designated points, and a general improvement of the river from its mouth to Lafayette, Ind., by means of light-draft boats and dredges, and until March 3, 1881, appropriations were applicable to this whole reach of river. The act of Congress of that date separated the river into two sections, with Vincennes, Ind., as the dividing point; since then specific appropriations have been made for each section. Otherwise the project has never been amended or revised, notwithstanding the fact that, with existing conditions, neither it nor the original estimates are applicable or adequate to the systematic improvement of the river.

From the commencement of the work in 1872 to March 31, 1881, the expenditures, all of which were for work below Vincennes, amounted to $324,845.44. Since March, 1881, expenditures for each section of the river are given below separately.

a. Below Vincennes.—From March, 1881, to June 30, 1896, expenditures for work below Vincennes amount to $354,086.19, including $25,000 expended for levee work at Grayville, Ill.

From 1884 to the present time the greater part of the appropriations for "below Vincennes" has been applied to the construction of a masonry lock and timber dam with masonry abutment at Grand Rapids. The lock, dam, and abutment have been completed, but guiding dikes below the lock remain to be built. Since the operations have been concentrated to complete the structures just mentioned, and necessarily suspended elsewhere on the river, the improvements at other places have rotted away or been damaged by ice and freshets, or the water has cut its way around them, thus leaving the river as badly obstructed as it was before its improvement was commenced and without any permanent aids to navigation and commerce other than the channels cut through solid rock and the lock and dam at Grand Rapids, which latter will be of little benefit unless the river is improved in such manner as to enable boats to reach that point. Therefore, considered as an entirety, this section of the river at a normal stage is not available for navigation.

There being no features requiring difficult engineering methods to overcome, it could be, with sufficient funds for regular operations, easily adapted to the requirements of commerce. The improvement, however, should begin at the mouth of the river and be systematically carried upstream.

Expenditures during the year amounted to $8,899.46, and were for the construction of the guide cribs above the lock at Grand Rapids; pro rata of expenses for the construction of a small light-draft towboat for use on this section of the river, that above Vincennes, and White River, Ind., and converting the good portions of the old snag boat *Osseo* into a properly equipped snag scow.

July 1, 1896, balance unexpended	$16,068.37
June 30, 1897, amount expended during fiscal year	8,899.46
July 1, 1897, balance unexpended	7,168.91
July 1, 1897, outstanding liabilities	150.75
July 1, 1897, balance available	7,018.16
Amount (estimated) required for completion of existing project	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

b. Above Vincennes.—Since this part of the river has become the object of specific appropriations, the sum of $83,509.15 was expended to June 30, 1896.

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Formerly a fairly good channel 3 feet in depth was maintained, but for several years past the appropriations have been too small to permit other than snagging operations at irregular times when the only boat available for such work was not in use elsewhere. The channel is only available at the higher stages of water. At low water the numerous snags, bars, and secondary channels render navigation, even with the lightest-draft boats, extremely uncertain.

The self-propelling snag boat formerly used for operations on this section of the river having become unfit for further work as a whole, the unserviceable portions were condemned and the other parts converted into a snag scow and fitted with proper equipments for such work. The expense of this, together with those for constructing a new light-draft towboat, were paid pro rata from funds for this section of the river, that below Vincennes, and White River, Indiana. No further operations were practicable during the fiscal year.

The present condition of the river precludes the establishment of any regular line or lines of boats. The only traffic over the river is during high stages, when several boats make irregular trips to transport corn, wheat, oats, and similar commodities to the nearest railway for reshipment.

Although every effort was made to obtain data that would give an accurate idea of the amount and character of commerce involved in the improvement of the river, it was found that correct statistics were not obtainable owing to lack of records.

July 1, 1896, balance unexpended	$7,990.85
June 30, 1897, amount expended during fiscal year	5,778.24
July 1, 1897, balance unexpended	2,212.61
Amount (estimated) required for completion of existing project	4,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	4,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix E E 3.)

4. Operating and care of lock and dam at Grand Rapids, Wabash River.—This lock and its dam were built from funds derived from appropriations for improving Wabash River, Indiana and Illinois. The operating expenses were also paid from that appropriation until March 1, 1897, since which date they have been paid from an allotment from the indefinite appropriation for operating and care of canals and other works of navigation, act July 5, 1884.

From March 1, 1897, to June 30, 1897, the expenses for the operation and care of the lock and dam aggregated $166.75.

The amount and character of commerce passing the lock during the fiscal year is given in Appendix E E 4 of this report.

(See Appendix E E 4.)

5. White River, Indiana.—Originally this river was, throughout the entire reach embraced within the project, badly obstructed by rock reefs, shoals, remains of old structures, and innumerable snags. It could be navigated only during high stages of water.

The original project is based upon the "report of examinations of the White River and its forks, Indiana," submitted December 31, 1878, by Maj. Jared A. Smith, Corps of Engineers, pursuant to which the first provision for improvement was made in the river and harbor act of March 3, 1879. The object was to provide a channel as far as might be practicable "without constructing locks and dams." A depth of 2

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feet is indicated, but no definite width for the channel is specified. This project, which has not as yet been revised or amended, provides for work estimated to cost $150,000.

The act of August 18, 1894, provided for a resurvey of the river. The survey has been made and a report in detail thereof will be found in House Doc. No. 47, Fifty-fourth Congress, second session. It is also submitted herewith as Appendix E E 12 of this report.

The total expenditures to June 30, 1896, were $116,903.87.

As a result of these expenditures, the lower 13 miles of White River are navigable for boats drawing 3 feet all the year; above this to the junction and about 5 miles up East Fork boats drawing 18 inches can navigate for about six months of the year. Low-water navigation on the forks is impracticable even for the smallest boats.

Owing to lack of records, no reliable statement of the amount and character of commerce involved in the improvement of the river could be procured.

July 1, 1896, balance unexpended	$3,096.13
June 30, 1897, amount expended during fiscal year	2,284.39
July 1, 1897, balance unexpended	811.74

(See Appendix E E 5.)

6. Tradewater River, Kentucky.—[This work was in the charge of Maj. James F. Gregory, Corps or Engineers, until May 14, 1897.] This river, before the work of improvement commenced, was practically closed by a rock bar near its mouth, and higher up by logs, snags, drift piles, leaning trees, and bars.

The present project, adopted in 1881, provides for clearing the river and its banks of obstructions, and opening a channel 40 feet wide and 2½ feet deep during six months of the year, the improvement to extend 41 miles upstream from its mouth in the Ohio.

Up to June 30, 1896, $15,941.70 had been expended, resulting in securing a channel through the rock bar near the mouth of the river, and in removing obstructions in the channel and on the banks of the river for a distance of 41 miles, the distance covered by the present project.

The amount expended during the fiscal year ending June 30, 1897, was $126.78, in care of property and incidental expenses.

It has been impossible to obtain any commercial statistics. Considerable coal and timber is, however, brought out of the stream, and the removal of the rock bar near the mouth of the stream, and the snags, overhanging trees, etc., higher up, has improved the facilities for handling the commerce.

July 1, 1896, balance unexpended	$558.30
June 30, 1897, amount expended during fiscal year	126.78
July 1, 1897, balance unexpended	431.52

(See Appendix E E 6.)

7. Lock No. 2, Green River, at Rumsey, Ky.—[This work was in the charge of Maj. James F. Gregory, Corps of Engineers, until May 14, 1897.] The deficiency act approved March 3, 1893, appropriated $65,000 for rebuilding this lock, which in 1892 was reported unsafe for navigation.

The project for this work, approved in 1893, calls for the construction of a new lock on the river side of the old lock, with certain changes of existing conditions to make them conform to location of lock.

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The amount expended to June 30, 1896, was $153,313.60, and resulted in the completion of the new walls, the partial dredging of new entrances, and the resumption of navigation through the new lock on December 8, 1895. The unexpended balance is sufficient to complete the project.

July 1, 1896, balance unexpended	$16,686.40
June 30, 1897, amount expended during fiscal year	6,766.14
July 1, 1897, balance unexpended	9,920.26

(See Appendix E E 7.)

8. Green River, above mouth of Big Barren River, Kentucky.—[This work was in the charge of Maj. James F. Gregory, Corps of Engineers, until May 14, 1897.] In pursuance of the provisions of act of September 19, 1890, an examination was made of this portion of Green River, and the report thereon, with project for the work proposed, was submitted to Congress as Appendix J J 15, Annual Report of Chief of Engineers, 1891.

The improvement proposed contemplated the construction of two locks and dams, so as to extend slack-water navigation to Mammoth Cave, at an estimated cost of $361,346.40.

The river and harbor act of July 13, 1892, appropriated $50,000 toward the construction of Lock No. 5, the project for which provides for the location and construction of a lock and dam at the head of slack-water navigation on the river.

The amount expended to June 30, 1896, was $6,540.95, in examinations and surveys for location of Lock No. 5, expenses of Board of Engineer Officers to determine location, making abstracts to fix title, and partially removing snags and other obstructions up to the proposed site of lock; for land on lock side of river and right of way to same, and the preparation of plans for the lock and dam. Title to land needed on abutment side of river has not been acquired.

Expenditures during the past year were for the construction of a lock-tender's dwelling, the transfer and erection of plant, temporary shops, storehouses, grading grounds, purchase of materials for construction of lock, and the work of excavating lock site, etc.

The commerce of upper Green River is at present almost entirely cross-ties and rafted timber. Its value is estimated at $125,000 per year. The completion of Lock No. 5 will open up a new territory rich in coal, timber, and iron-ore lands, and the commerce should, in a few years, show a great increase.

At present the country bordering on upper Green River is dependent on the stream for means of transportation.

July 1, 1896, balance unexpended	$88,459.05
June 30, 1897, amount expended during fiscal year	10,008.10
July 1, 1897, balance unexpended	78,450.95
July 1, 1897, outstanding liabilities	5,590.46
July 1, 1897, balance available	72,860.49
Amount (estimated) required for completion of existing project	85,673.20
Amount that can be profitably expended in fiscal year ending June 30, 1899	85,673.20
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix E E 8.)

9. Operating and care of locks and dams on Green and Barren rivers, Kentucky.—[This work was in the charge of Maj. James F. Gregory,

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Corps of Engineers, until May 14, 1897.] When the United States acquired possession of these improvements, December 11, 1888, navigation of the system was broken at Lock No. 3, Green River, the river wall at that lock having fallen into the river; the lower end of the land wall at No. 1, Barren River, was badly cracked and liable to fall at any time, and both walls of No. 2, Green River, were in a dangerous condition.

The channel of the river was much obstructed by snags and slides.

The operations up to June 30, 1896, resulted in the rebuilding of the old river wall at Lock No. 3; the taking down and reconstruction of the lower half of the river wall at No. 1, Barren; the rebuilding of Dams Nos. 1, 3, and 4, Green River, and No. 1, Barren River; grading and paving behind the lock walls at the different locks, with the exception of No. 2, Green; building and placing new upper gates at Lock No. 1; the building of seven lock houses, and the construction of a snag boat and various barges and derrick boats required in the prosecution of the work.

The amount expended during the fiscal year ending June 30, 1897, was $63,090.18, in operating and maintaining the five locks and dams, the snag boat engaged in towing and pulling snags, the dredge boat engaged in clearing out lock, lock pits, entrances, and removing land slides and bars.

A new hull for the dredge boat was constructed, and materials required for new upper gates at Lock No. 4, Green, and No. 1, Barren, were contracted for and their construction completed.

Lock No. 2, Green, has been rebuilt and reopened to navigation, under an appropriation for improving Green River, Kentucky, rebuilding Lock No. 2.

The commerce of Green and Barren rivers during the ten years that the United States has had charge of the improvements has amounted to 4,367,860 tons, or an average of 436,786 tons per annum. The commerce consists principally of coal, live stock, merchandise, leaf tobacco, timber, logs, and handles.

(See Appendix E E 9.)

10. Rough River, Kentucky.—[This work was in the charge of Maj. James F. Gregory, Corps of Engineers, until May 14, 1897.] This river was originally very much obstructed by overhanging trees on the banks, and by snags, logs, etc., in the bed of the river. The lower 8 miles of the stream are affected by backwater from the Rumsey Dam (No. 2) on Green River, but above this point the stream had but little depth at low water.

The project for improvement, adopted in 1890, is to clear the river of obstructions and to locate and construct a lock and dam near the site of the old ones to carry slack water to Hartford.

The amount expended to June 30, 1896, was $57,144.10, and resulted in the removal of snags and deadening trees from the mouth of the river to Hartford and the removal of the deadened trees up to the site of the lock, preparing site for cofferdam inclosing the lock, and the commencement of excavation; purchase of the necessary plant and the excavation for and completion of river wall of lock and the abutment, the excavation for the land wall, the dredging of the river for 1,000 feet below the site of the new lock, and the removal of both walls of the old lock to a point where they would not interefere with navigation.

Work during the past fiscal year resulted in the completion of the lock and dam and lock tender's residence, the grading of grounds in

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the vicinity of the lock, and opening the lock to navigation during the month of December, 1896.

The completion of the lock and dam provides water transportation for agricultural products, such as tobacco, corn, hay, etc., from and about Hartford, and for coal that extends along the stream from the lock site to Hartford.

The unexpended balance is sufficient to complete work remaining to be done under the project.

July 1, 1896, balance unexpended	$48,355.90
June 30, 1897, amount expended during fiscal year	35,593.46
July 1, 1897, balance unexpended	12,762.44
July 1, 1897, outstanding liabilities	102.60
July 1, 1897, balance available	12,659.84

(See Appendix E E 10.)

EXAMINATION AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACTS OF JUNE 3, 1896, AND AUGUST 18, 1894.

The preliminary examination and surveys of the following localities, required by the acts of June 3, 1896, and August 18, 1894, were made by the local engineers, and reports thereon submitted through the division engineer, Col. Henry M. Robert, Corps of Engineers:

1. Preliminary examination of Treadwater (Tradewater) River, Kentucky.—This examination was authorized by the act of June 3, 1896, and Maj. James F. Gregory, Corps of Engineers, submitted report thereon February 9, 1897. Tradewater River has been under improvement by the United States since 1881, and it is the opinion of the local officer, concurred in by the division engineer and by the Chief of Engineers, that the river is not worthy of improvement by the General Government beyond the present approved project of keeping the channel free from snags and other obstructions. The report was transmitted to Congress and printed in House Doc. No. 4, Fifty-fifth Congress, first session. (See also Appendix E E 11.)

2. Survey of White River, Indiana.—The act of August 18, 1894, made provision for a resurvey of White River, and Capt. J. G. Warren, Corps of Engineers, submitted report thereon May 13, 1896. The project presented proposes extension of 3-foot depth, now existing in the lower 13 miles of the river, to Blackburn Station, 46 miles above the mouth of the river; improvement of the East Fork so as to afford a depth limited to 2 feet, and improvement of West Fork to be effected by the use of locks and dams, three of which will be required to give a low-water depth of 2 feet to the Falls. The estimated cost of the work mentioned is $549,977. In regard to the locks and dams proposed for the West Fork, the local officer states that further examination will be required for their location, but by the location of one of them at or near Rocky Ford Ripple, 42½ miles from the mouth of White River, certain of the regulation works for the East Fork would be rendered superfluous and the estimate diminished correspondingly, making the total estimated cost of the improvement $465,946. In addition to this, the caving of unstable banks would render necessary an annual expenditure for snagging and dredging of at least $6,000, or an expensive system of bank protection. Captain Warren remarks that these figures indicate that the cost of the improvement is far in excess of what would be justified by the present demands of commerce; in view of which he submits that the improvement of White River should be

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suspended until the navigation of the Wabash has been so improved as to afford an outlet for any traffic which may then be developed on the White. This opinion is concurred in by the division engineer. The report was transmitted to Congress and printed in House Doc. No. 47, Fifty-fourth Congress, second session. (See also Appendix E E 12.)

3. Survey of Green River, Kentucky, at or near its mouth, for new lock and dam.—This survey, authorized by the act of June 3, 1896, was assigned to the charge of Maj. James F. Gregory, Corps of Engineers, who submitted report thereon April 3, 1897. Two sites are indicated at which the proposed lock and dam can be constructed, at an estimated cost of $228,717.50 and $294,800, respectively. The relative merits of the two locations are presented in the report. It is the opinion of the local officer, concurred in by the division engineer, that the proposed improvement is not at present justified by the interests of commerce involved. The report was transmitted to Congress and printed in House Doc. No. 30, Fifty-fifth Congress, first session. (See also Appendix E E 13.)

IMPROVEMENT OF CERTAIN RIVERS IN KENTUCKY AND WEST VIRGINIA, AND OF NEW RIVER, VIRGINIA AND WEST VIRGINIA.

This district was in the charge of Maj. James F. Gregory, Corps of Engineers, with Lieut. W. W. Harts, Corps of Engineers, under his immediate orders. Division Engineer, Col. Henry M. Robert, Corps of Engineers.

1. Kentucky River, Kentucky.—At the time the project was adopted, in 1879, the five locks and dams, built by the State of Kentucky many years ago, were in a dilapidated condition, and had been practically abandoned and allowed to go to ruin by the State. The channel was also much obstructed by snags and leaning trees. Portions of Dams Nos. 1 and 2, in the lower part of the stream, were gone entirely, so that navigation was suspended.

The original, and present, project was adopted in 1879 (report printed in the Annual Report of the Chief of Engineers for 1879, pp. 1398–1422), and provided for repairing and rebuilding the five old locks and dams, removing snags, logs, and other obstructions, and extending 6 feet of slack-water navigation up the stream to Three Forks, a distance of about 261 miles from the mouth of the river in the Ohio at Carrollton, Ky.

Amount expended to June 30, 1896, $1,508,440.88, resulting in repairing and rebuilding the five old locks and dams originally constructed by the State, and in building Lock and Dam No. 6, with their appurtenances, complete (extending slack-water navigation up to High-bridge, Ky., 121 miles above Carrollton), and the partial construction of Lock No. 7, a short distance below High-bridge. All this work has required the construction of some new dams, practically rebuilding others, the construction of new abutments and extensive guide and retaining walls, the replacing of old miter walls and sills with new ones, and the construction and placing of new lock gates, the construction of a towboat, and the purchase of many tools and much machinery necessary to prosecute the work.

Amount expended during the fiscal year ending June 30, 1897, $178,898.74, was in the purchase and delivery of the stone and cement for and the partial completion of the walls of Lock No. 7, the purchase of materials for and the construction of the lock gates, the purchase and delivery of all the timber and spikes required in the construction of the

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dam, and the commencement of the work preliminary to the construction of the dam. The work has been carried on by hired labor, with materials purchased under contract.

For the commercial statistics of this stream, see report on operating and care of the locks and dams in Kentucky River.

The river and harbor act of June 3, 1896, provided as follows:

Improving Kentucky River, Kentucky: Continuing improvement, fifty thousand dollars: *Provided*, That contracts may be entered into by the Secretary of War for such materials and work as may be necessary to complete the present project of improvement, to be paid for as appropriations may from time to time be made by law, not exceeding in the aggregate one million three hundred and forty-nine thousand dollars, exclusive of the amount herein appropriated: *Provided*, That of the amount authorized to be expended eighty-three thousand dollars, or so much thereof as may be necessary, may be expended, in addition to the fifty thousand dollars herein appropriated, in continuing construction and completion of Lock and Dam Numbered Seven, by contract or otherwise.

And the sundry civil act approved June 4, 1897, provided for the following:

Improving Kentucky River, Kentucky: For continuing the construction of Locks and Dams Numbered Seven and Eight, two hundred thousand dollars; and the provision of the "Act making appropriations for the construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes," approved June third, eighteen hundred and ninety-six, relating to improving Kentucky River, Kentucky, is hereby amended to read as follows: "*Provided*, That contracts may be entered into by the Secretary of War for such materials and work as may be necessary to prosecute work on said improvement in accordance with the present project for same, to be paid for as appropriations may from time to time be made by law, not exceeding in the aggregate one million three hundred and forty-nine thousand dollars, exclusive of the amount herein and heretofore appropriated: *Provided*, That of the amount authorized to be expended eighty-three thousand dollars, or so much thereof as may be necessary, may be expended in addition to the fifty thousand dollars herein appropriated in continuing construction and completion of Lock and Dam Numbered Seven, by contract or otherwise, and said eighty-three thousand dollars shall be immediately available: *Provided further*, That in making such contract or contracts the Secretary of War shall not obligate the Government to pay in any one fiscal year, beginning July first, eighteen hundred and ninety-seven, more than twenty-five per centum of the whole amount authorized to be expended."

The following explanation was made in the Annual Report of the Chief of Engineers for 1896 (Part I, p. 296) with reference to the act of June 3, 1896:

The limit of cost of this improvement, as fixed by law, is based on an estimate originally prepared in 1883 from the best information then available. Experience and additional information gained since that date show that, if slack-water navigation is to be carried up to Beattyville, the original estimate for lock construction and other portions of the improvement must be revised and materially increased, and, in addition to such increase of original cost, the expense of maintenance of the entire system will be about $100,000 per year. With the funds available the work upon Lock No. 7 will be pushed to completion, and it is believed to be desirable that further construction under the law be delayed until Lock No. 7 is completed. The cost of this work will furnish important information in connection with a revision of estimates for the entire improvement heretofore considered, and the benefits resulting to navigation may have an important bearing on the question of a further extension of this improvement.

Since the above explanation, work has progressed on Lock No. 7, and the experience gained in its construction confirms the belief that the original estimate for lock construction and other portions of the improvement must be revised and materially increased if slack-water navigation is to be carried up to Beattyville, and that the expense of maintenance of the entire system will be about $100,000 per year after it is completed. The benefits which would result from extending slack water above the pool to be furnished by Dam No. 7 up to Beattyville,

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a distance of about 140 miles, can not be foretold. They are not now apparent.

The amount (estimated) required for completion of existing project, $1,066,000, is the unappropriated balance of the estimate of 1883. As explained above, this estimate will have to be increased.

The amount submitted as estimate of funds that can be profitably expended during the fiscal year ending June 30, 1899, is the proportion of the total amount authorized by Congress to be expended up to that date.

July 1, 1896, balance unexpended		$247,559.12
Amount appropriated by sundry civil act approved June 4, 1897		200,000.00
		447,559.12
June 30, 1897, amount expended during fiscal year		178,898.74
July 1, 1897, balance unexpended		268,660.38
July 1, 1897, outstanding liabilities	$12,689.77	
July 1, 1897, amount covered by uncompleted contracts	2,557.68	
		15,247.45
July 1, 1897, balance available		253,412.93
Amount (estimated) required for completion of existing project		1,066,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		391,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix F F 1.)

2. Operating and care of locks and dams in Kentucky River, Kentucky.—At the time the United States acquired possession of the five locks and dams in this stream in 1880, consequent to the report printed in the Annual Report of the Chief of Engineers for 1879 (pp. 1398–1422), navigation was practically suspended, on account of the fact that the works required repairing and rebuilding. These five locks and dams were built by the State of Kentucky in 1835–1839, and from 1880 up to 1885 were extensively repaired by the United States under the appropriation for improving Kentucky River, Kentucky.

Since 1884, when the indefinite appropriation for operating and caring for canals, etc., was created, the works have been cared for and operated under that appropriation. Lock and Dam No. 6 were built by the United States and added to the system in 1891. Lock and dam at Highbridge, Ky., are now being built under the appropriation for improving Kentucky River, Kentucky.

The amount expended to June 30, 1896, was for operating and caring for the locks and dams and their appurtenances, and in rebuilding and maintaining from time to time such parts of the works as required it.

The amount expended during the fiscal year ending June 30, 1897, $71,552.03, was in the payment of the salaries of the lockmen engaged in operating the locks, in keeping the river free from snags and sand bars, the removal of old wooden miter sill at Lock No. 2 and the construction of a stone one instead of the wooden one, the rebuilding of some guide cribs at the entrances of the locks, and the construction of two dump scows needed to take the places of two old ones which have become unserviceable.

(See Appendix F F 2.)

3. Tug Fork of Big Sandy River, West Virginia and Kentucky.—In its original condition this stream was much obstructed by rocks, snags, logs, and overhanging trees.

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The project, adopted in 1880 (Annual Report, Chief of Engineers, 1875, pp. 756–769), provided for removing the natural obstructions in the stream and the construction of low wing dams of loose stones at shoal places, so as to aid the floating of timber and light-draft steamboat navigation.

The amount expended to June 30, 1896, was $25,655.22, resulting in the material improvement of navigation, giving increased facilities for push boats at low water, and rafting and light-draft steamboats at moderate stages, for the distance of 100 miles upstream from Louisa, Ky.

The expenditures during the fiscal year ending June 30, 1897, were applied to removing obstructions that had re-formed since the stream was last cleared up and to repairing the loose-stone dams.

The Tug and Levisa forks unite at Louisa, Ky., to form the Big Sandy River, and the record of the commerce of the three streams has not been separately kept. The principal article of commerce of Tug Fork at present is timber, although a great deal of farm produce is also handled. The amount of commerce handled on the stream can not well increase until the latter is improved by locks and dams, which form of improvement was favorably reported on in the Annual Report of the Chief of Engineers for 1889 (pp. 1990–1994). The country bordering on this stream abounds in coal of good quality, but it can not be marketed until means of cheap transportation are provided.

July 1, 1896, balance unexpended	$2,094.78
June 30, 1897, amount expended during fiscal year	1,356.03
July 1, 1897, balance unexpended	738.75
Amount that can be profitably expended in fiscal year ending June 30, 1899 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	1,500.00

(See Appendix F F 3.)

4. Levisa Fork of Big Sandy River, Kentucky.—In its original condition this stream was much obstructed by rocks, snags, logs, overhanging trees, and its pools were separated by rocky and sandy bars and shoals.

The project adopted in 1880 (Annual Report, Chief of Engineers, 1875, pp. 756–769) provided for removing the natural obstructions in the stream and the construction of low wing dams of loose stones at shoal places, so as to deepen the water at those places for the purpose of aiding the floating of timber and light-draft steamboat navigation.

Up to June 30, 1896, $25,642.88 was expended in removing obstructions and constructing low, loose-stone dams, resulting in the material improvement of navigation, giving increased facilities for push boats at low water and rafting and light-draft steamboats at moderate stages.

Expenditures during fiscal year ending June 30, 1897, were applied to removing obstructions that had re-formed since the stream was last cleared up and to repairing the loose-stone dams.

The Levisa and Tug forks unite at Louisa, Ky., to form the Big Sandy River, and the record of the commerce of the three streams has not been separately kept. The principal article of commerce of Levisa Fork at present is timber, although a great deal of farm produce, groceries, etc., is also handled above the terminus of the railroad at White House, or Myrtle, and above which the country for 75 miles is now unusually thickly settled. The amount of commerce handled on the stream can not well increase until the latter is improved by locks and dams, which form of improvement was favorably reported on in the Annual Report of the Chief of Engineers for 1889 (pp. 1990–1994), so that the means of transportation will be provided for the almost unlim-

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ited quantities of bituminous, cannel, and coking coal of good quality which exists along the stream.

A dike in Levisa Fork, at or near the mouth of Georges Creek, has become a necessity, as the stream has spread over a large area of land. A steamboat and many rafts were destroyed at this point during the past year. A dike would concentrate the water at that point and cause a channel to form which could be relied on.

July 1, 1896, balance unexpended	$1,107.12
June 30, 1897, amount expended during fiscal year	1,013.05
July 1, 1897, balance unexpended	94.07
Amount that can be profitably expended in fiscal year ending June 30, 1899	11,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix F F 4.)

5. Big Sandy River, West Virginia and Kentucky.—In its original condition this river and its forks were much obstructed by rocks, bars, snags, and leaning trees. During the low-water period of each year navigation was practically suspended.

The original project, providing for the removal of rocks, snags, and overhanging trees from the main stream and the Levisa and Tug forks, which unite at the town of Louisa, Ky., to form the main stream, was for "improving Big Sandy River from Catlettsburg, Ky., to the head of navigation," and was adopted in 1878 (Annual Report, Chief of Engineers, 1875, pp. 756–769). This improvement was for the purpose of aiding light-draft steamboat, push-boat, and rafting navigation in the main river and the Tug and Levisa forks.

The project of 1878, for the improvement of the Big Sandy proper, was modified in 1880 so as to provide for the construction of a lock and fixed dam in that stream at Louisa, immediately below the junction of Levisa and Tug forks. In 1891, after the lock and a portion of the fixed dam at Louisa had been completed, the protests of those interested in the timber business against a fixed dam caused a Board of Officers of the Corps of Engineers to be convened to consider and report upon the subject of the dam, etc., and in its report, dated November 10, 1891 (Annual Report, Chief of Engineers, 1892, Part III, pp. 2101–2108), the Board recommended the substitution of a needle (movable) dam for the proposed fixed dam. This change of project was approved November 20, 1891.

The sum of $341,458.05 was expended to June 30, 1896, resulting, between 1878 and 1880, in improving low-water navigation by the removal of logs, stumps, snags, trees, and other obstructions from the bed of the river, as contemplated by the original project of 1878; the construction of a lock 185 feet long between hollow quoins and 52 feet wide and a portion of the fixed dam, under the modified project of 1880; and in the reconstruction of the lock so as to conform to the requirements of the needle dam instead of a fixed dam, the construction of the abutment for the dam, and the masonry of the navigation pass, pier, and weir of the latter, ready to receive the movable ironwork, etc., all in accordance with the modified project of 1891 providing for the construction of the movable dam instead of a fixed dam.

Expenditures during fiscal year ending June 30, 1897, were applied to the construction of lock gates and placing them in position, to purchasing by contract all the ironwork of the movable dam and placing same in position in the weir and navigation pass; methods for raising and lowering the dam were provided. The dam was operated for the first time on January 1, 1897.

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Commercial statistics.

	Tons.
1890	268,582
1891	277,303
1892	455,926
1893	466,723
1894	297,800
1895	545,910
1896	471,382
1897	414,500

The above is the commerce of the three streams—Big Sandy proper, from Louisa, Ky., to its mouth in the Ohio at Catlettsburg, Ky., a distance of 26 miles, and of Levisa and Tug forks, which unite at Louisa to form the main river. This commerce consists of timber and farm products. The amount of commerce can not well increase until the main river, below Louisa, and Levisa and Tug forks, above the limit of the slack water furnished by the needle dam completed at Louisa during the past year, are improved by locks and dams, which form of improvement was favorably reported on in the Annual Report of the Chief of Engineers for 1889 (pp. 1990–1994).

The country bordering Levisa and Tug forks abounds in bituminous, cannel, and coking coal of good quality, but it remains undeveloped for lack of transportation facilities. All the appropriations made since 1880 for the main river have stipulated that the funds should be expended in constructing the lock and dam near Louisa, so that nothing has been done toward the removal of natural obstructions in the main river between the lock and Catlettsburg for about seventeen years. This portion of the river has become more or less obstructed in that time, and it is estimated that these obstructions may be cleared out at a cost of $2,000.

July 1, 1896, balance unexpended	$38,541.95
June 30, 1397, amount expended during fiscal year	32,205.58
July 1, 1897, balance unexpended	6,336.37
July 1, 1897, outstanding liabilities	598.61
July 1, 1897, balance available	5,737.76
Amount that can be profitably expended in fiscal year ending June 30, 1899 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	2,000.00

(See Appendix F F 5.)

6. Guyandotte River, West Virginia.—The stream was practically closed before work was commenced. It was once improved by the State of Virginia by the construction of six timber locks and dams. These timber structures decayed, were abandoned, and became themselves obstructions to navigation. They were finally carried away from time to time by floods, and at the time the improvement was commenced by the United States the principal obstructions were snags, rocks, overhanging trees, and shoals.

The original project was adopted in 1878 (Annual Report, Chief of Engineers, 1875, part 1, pp. 747–755), and provided for removing such natural obstructions as snags, rocks, and overhanging trees, and concentrating and deepening the water over the shoals by throwing up low wing dams of loose stones, so as to aid light-draft steamboat navigation in the lower portion of the stream and the floating of timber down to the Ohio and thence to market.

Up to June 30, 1896, $20,266.20 had been expended, resulting in the

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partial improvement of the river for the distance of 119 miles upstream from its mouth, removing snags, logs, etc., cutting passageways through old dams, and constructing low dams of loose stones to deepen the water on shoals.

During fiscal year ending June 30, 1897, the expenditures were for maintaining the channel contemplated by the project.

Commercial statistics.

	Tons.		Tons.
1891	61,128	1895	247,400
1892	103,800	1896	202,000
1893	182,250	1897	143,300
1894	141,221		

This commerce consists almost entirely of timber, cross-ties, etc.

July 1, 1896, balance unexpended	$1,233.80
June 30, 1897, amount expended during fiscal year	1,152.59
July 1, 1897, balance unexpended	81.21
Amount that can be profitably expended in fiscal year ending June 30, 1899 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	1,000.00

(See Appendix F F 6.)

7. New River, Virginia and West Virginia.—[This work was in the charge of Col. Peter C. Hains, Corps of Engineers, until April 30, 1897.] In its original condition the navigable channel consisted of natural chutes through the ledges and shoals; the chutes were of varying widths, and there was rarely over 1 foot of water at such points.

The original project was adopted in 1876 (report printed in the Annual Report of the Chief of Engineers for 1873, pp. 842–854), and provided for improving the stream from the lead mines in Wythe County, Va., to the mouth of Greenbrier River, West Virginia, by widening the channels from 30 to 50 feet, as might be required, deepening them to 2 feet, and straightening such as needed it for bateau navigation; the improvement, however, to be made in such manner as would aid the work should greater depth and width be required in the future.

The extension of the improvements from the lead mines in Wythe County, Va., up to the mouth of Wilson Creek in Grayson County, Va., was provided for in the act of Congress of June 14, 1880. (Report on pp. 133–139, part 2 of the Annual Report of the Chief of Engineers for 1875, and report on pp. 538–545, part 1, of the Annual Report of the Chief of Engineers for 1879.)

The sum of $109,691.06 was expended up to June 30, 1896, for open-river navigation.

There were no expenditures during fiscal year ending June 30, 1897. The unexpended balance is, by the act of Congress of August 5, 1886, available for expenditure between the lead mines and Wilson Creek. As conditions have changed in late years, the further improvement of that portion of the stream has been reported as entirely unnecessary, and the Secretary of War has decided not to expend the existing balance at present.

July 1, 1896, balance unexpended	$2,308.94
July 1, 1897, balance unexpended	2,308.94

(See Appendix F F 7.)

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8. Gauley River, West Virginia.—[This work was in the charge of Col. Peter C. Hains, Corps of Engineers, until April 30, 1897.] The country at the head waters of this stream, and its tributaries, is covered with forests of the finest timber. For the first 12 miles from its mouth in the Great Kanawha River, or junction with New River, the Gauley falls only 4 feet per mile; in the next 26 miles its fall is nearly 34 feet per mile, in a gorge, the hills on either side being several hundred feet high and almost perpendicular, and the stream full of bowlders, some very large, and so numerous as to justify the name of "Roughs of Gauley" which has been given that section.

The project was adopted in 1888 (report of examination dated December 26, 1887, Annual Report, Chief of Engineers, 1888, Part III, pp. 1761–1767), and provided for 2-foot navigation for bateaux carrying 8 to 10 tons, and for rafts of logs, sawed stuff, railroad ties, etc., from the mouth of the river to the foot of the "Roughs," about 12 miles, and for improving the condition of the Roughs for about 28 miles farther, by blasting down the huge bowlders which formed such formidable obstructions.

The sum of $10,969.28 was expended up to June 30, 1896, principally below the Roughs, in providing and maintaining 2-foot navigation for bateaux and for rafts, and in commencing work at the Roughs.

The expenditure during fiscal year ending June 30, 1897, was in the payment of outstanding liabilities of the previous year.

The season for economical operations in this stream is limited to a short period each year, when the stage of water is low and the temperature of it is warm. It is proposed to resume work when these necessary conditions again exist.

The commercial statistics of the stream show that its commerce consists almost wholly of timber. The commerce can not well increase until the great obstructions in the section known as the Roughs are removed or at least reduced, and this work will require larger appropriations than have been heretofore made.

July 1, 1896, balance unexpended	$4,030.72
June 30, 1897, amount expended during fiscal year	333.69
July 1, 1897, balance unexpended	3,697.03
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	60,000.00

(See Appendix F F 8.)

9. Elk River, West Virginia.—[This work was in the charge of Col. Peter C. Hains, Corps of Engineers, until April 30, 1897.] The stream is one of the chief tributaries of the Great Kanawha, emptying into it at Charleston, W. Va. Its course is tortuous, but the country through which it flows is rich in minerals and well fitted for agriculture and grazing. The stream was originally much obstructed by snags, rocks, overhanging trees, and was a succession of pools separated by rapids over shoals, over which latter, during dry seasons, there was but a few inches of water.

The project was adopted in 1878 (Annual Report, Chief of Engineers, 1876, part 2, pp. 166–176), and provided for improving the stream for bateau navigation by cutting sluices through the shoals. The estimated cost of this "open" navigation was placed at $100,000.

Up to June 30, 1896, $26,622.05 was expended, which resulted in the removal of snags, rocks, overhanging trees, the construction of cheap regulating dams to concentrate the water at some of the worst shallow

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places, and the making of narrow sluices through some of the rapids and shoals, so as to aid the transportation of country produce downstream in small boats and the return of the latter with merchandise, and also the floating of timber to market.

Expenditures during fiscal year ending June 30, 1897, were applied to removing some obstructions that had lodged in the channel of the stream 14 miles above Charleston.

The resumption of the work of actively removing the obstructions, with the appropriation of June 3, 1896, that have re-formed since the stream was last cleared up is held in abeyance pending the outcome of proceedings instituted by the United States attorney for the district of West Virginia for the purpose of securing the removal of the Frametown and Ashley dams, the principal obstructions now in the stream.

Commercial statistics.

	Tons.		Tons.
1883	24,790	1891	103,700
1884	30,700	1892	139,800
1885	33,500	1893	125,400
1886	68,510	1894	92,630
1888	71,150	1895	112,100
1889	70,200	1896	92,000
1890	89,880		

This commerce has consisted almost entirely of timber—logs, lumber, ties, and staves.

July 1, 1896, balance unexpended	$3,877.95
June 30, 1897, amount expended during fiscal year	381.65
July 1, 1897, balance unexpended	3,496.30
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	69,000.00

(See Appendix F F 9.)

10. Great Kanawha River, West Virginia.—[This work was in the charge of Col. Peter C. Hains, Corps of Engineers, until April 30, 1897.] This river flows through a region rich in mineral wealth, especially coal and salt. It was originally divided into a number of pools separated by shoals of gravel and coarse sand, which were the principal obstructions to navigation during the low-water period of each year, there being but a few inches of water on the shoal places at such times. Navigation was practically suspended in summer.

The original project, adopted in 1873, provided for removing large bowlders from the channel, excavating channels through the shoals, and the construction of riprap dams and dikes, the object being to increase the depth of water on the shoal places so as to enable towboats to use the stream for a longer period each year than the natural condition of the stream permitted.

The modified project, adopted in 1875, provided for obtaining the depth of 6 feet of water all the year round throughout the whole river, 96 miles, by the construction of locks with movable dams from the mouth in the Ohio, at Point Pleasant, W. Va., up to Paint Creek, about 79 miles above Point Pleasant, and locks with fixed dams above Paint Creek, the declivity of the river above Paint Creek being too great to permit of the advantageous use of movable dams. The original estimated cost of this improvement was placed at $4,153,000. This sum was somewhat reduced by reducing the total number of locks and dams from 12 to 11, one of the locks and dams originally estimated for in the

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lower portion of the river having been found, after more detailed examination, unnecessary. The original project also provided for three locks with fixed dams in the upper part of the river; only two of these have been constructed, Nos. 2 and 3, the construction of No. 1 having been dispensed with until its necessity became more apparent. By dropping these two locks and dams from the original project the original estimate was reduced by about $600,000. However, the revised estimate of 1892 (Annual Report, Chief of Engineers, 1892, pp. 2042–2044) showed that $1,305,700 still remained to be supplied by Congress in order to complete the project. This amount was furnished by the acts of Congress of July 13, 1892, March 3, 1893, and March 2, 1895. The estimate of 1892 was made, however, before the exact site of Lock and Dam No. 11 had been selected, before a thorough knowledge of the amount of dredging between locks was had, and before the existence of the law limiting a day's work of a Government employee to eight hours. A revised estimate was therefore found necessary in 1896, and the amount of it, $273,000, was furnished by the sundry civil act of June 4, 1897. It is thought the project may be completed without further appropriations.

Up to June 30, 1896, there was expended, under the original project of 1873, $50,000, and under the modified project of 1875, $3,399,929.68; total, $3,449,929.68.

Up to June 30, 1896, the work accomplished resulted in removing the worst natural obstructions to navigation, the purchase of a towboat and a dredge, the dredging of channels at various points, the construction complete of Locks and Dams Nos. 2, 3, 4, 5, 6, 7, and 8, the completion of the masonry work of Locks Nos. 9, 10, and 11 excepting the laying of a small amount of coping stone at each of those locks, and the commencement of the construction of Dams Nos. 9, 10, and 11, viz:

No.	Distance above Point Pleasant.	Style of dam.	Completed in—	Remarks.
	Miles.			
2	84¼	Fixed	1887	In operation.
3	79½	.....do	1882	Do.
4	73	Movable	1880	Do.
5	67¼	.....do	1880	Do.
6	54	.....do	1886	Do.
7	44	.....do	1893	Do.
8	36	.....do	1893	Do.
9	25¼	.....do	.....	Under construction.
10	18¾	.....do	.....	Do.
11	1¾	.....do	.....	Do.

Also the construction of a telephone line connecting the office of the assistant engineer at Charleston, W. Va., with the different locks and dams. The development of commerce on this river has been very great since its improvement was commenced by the United States, although the three locks and dams in the lower portion of the stream are not completed. About nine-tenths of this commerce consists of coal.

Expenditures during fiscal year ending June 30, 1897, were applied to completing the work of laying coping stone on the walls of Locks Nos. 9, 10, and 11; the purchase of timber and ironwork for, and the partial completion of, the gates for those locks; in continuing the work of constructing the foundations of Dams Nos. 9, 10, and 11, their abutments and center piers; purchasing and placing in position nearly all of the fixed and movable ironwork for the navigation pass and weir of each

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of those dams, and purchasing timber for, partially constructing, and partially placing in position the wickets for the navigation pass and weir of each of the three unfinished dams. The stream was dredged at various points, the United States plant being used for the purpose.

The commercial statistics show that, commencing with the year 1890, the principal commodity has been coal, although a great deal of timber also is handled on the stream.

	Tons.		Tons.
1890	1,127,232	1894	1,222,530
1891	1,225,355	1895	1,082,342
1892	1,360,750	1896	1,162,782
1893	1,116,537		

July 1, 1896, balance unexpended		$485,270.32
Amount appropriated by sundry civil act approved June 4, 1897		273,000.00
		758,270.32
June 30, 1897, amount expended during fiscal year		204,591.07
July 1, 1897, balance unexpended		553,679.25
July 1, 1897, outstanding liabilities	$19,195.91	
July 1, 1897, amount covered by uncompleted contracts	408,172.73	
		427,368.64
July 1, 1897, balance available		126,310.61

(See Appendix F F 10.)

11. Operating and keeping in repair the seven finished locks and dams in the Great Kanawha River, West Virginia.—[This work was in the charge of Col. Peter C. Hains, Corps of Engineers, until April 30, 1897.] The two finished locks with fixed dams, known as Nos. 2 and 3, in the upper portion of the stream and the five finished locks, with movable dams, known as Nos. 4, 5, 6, 7, and 8, in the river below Nos. 2 and 3, were constructed under the appropriations for improving Great Kanawha River, West Virginia. The location, etc., of the seven finished locks and dams, and of the three locks and dams to be known as Nos. 9, 10, and 11, now under construction under the appropriation for improving Great Kanawha River, West Virginia, is shown in the Annual Report of the Chief of Engineers for 1896, Part IV, pages 2247.

The amount expended up to June 30, 1896, was $258,055.93, in operating and caring for the finished locks and dams, making renewals of those parts of the finished works which have deteriorated from use and exposure, and in dredging deposits from the lock chambers and entrances, and some channels between locks originally formed by dredging under the appropriations for improving Great Kanawha River.

The amount expended during the fiscal year ending June 30, 1897, was $26,868.30, in payment of the salaries of the lockmen employed at the seven finished locks and dams to operate and care for those works, making minor repairs and renewals at those locks and dams, dredging deposits from the lock chambers and entrances, and maintaining, by dredging, some channels between locks originally formed by dredging under the appropriation for improving Great Kanawha River.

The commerce of the Great Kanawha River since 1889 has been as follows:

	Tons.		Tons.
1890	1,127,232	1894	1,222,530
1891	1,225,355	1895	1,082,342
1892	1,360,750	1896	1,162,782
1893	1,116,537	1897	1,124,843

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While the commerce has not increased to any great extent since 1889, there has been an enormous increase since the improvement of the stream by the construction of locks and dams, commenced in 1875, was begun. The principal commodity has been coal, although a great deal of timber also has been handled in the stream. It is expected that the completion of Locks and Dams Nos. 9, 10, and 11 will cause a still further increase of commerce.

(See Appendix F F 11.)

12. Little Kanawha River, West Virginia.—There were four locks and dams in the stream, owned and controlled by the Little Kanawha Navigation Company, which afforded slack-water navigation from Parkersburg up to a point 2 miles above Burning Springs, W. Va., or a total distance upstream from Parkersburg of 40 miles. Above Burning Springs the river was much obstructed by logs, snags, bowlders, leaning trees, etc., rendering the floating of timber, the principal commodity, very hazardous.

The original project, adopted in 1877, provided for the removal of Beaver and Nailor Bend rocks, 53 and 54 miles, respectively, above Parkersburg, and for clearing the stream, above Burning Springs, of snags and overhanging and fallen trees.

There was added to the original project, by the act of Congress of June 14, 1880, provision for the construction of a lock and dam 2 miles above Burning Springs. The amount expended up to June 30, 1896, was $211,175. At that date the upper part of the stream had been placed in a fair condition for timber-floating purposes, and so that, on moderate rises, light-draft steamboats could run as far as Grantsville, 78 miles above Parkersburg. The lock and dam known as No. 5 of the system, and their appurtenances, 2 miles above Burning Springs, were completed and opened to navigation on December 2, 1891. This lock and dam, and the four locks and dams owned by the navigation company, afford 4 feet of slack-water navigation up to Creston, 50 miles above Parkersburg, when the supply of water in the stream is greater than the leakage through the dams of the navigation company, the condition of which is fully described in the Annual Report of the Chief of Engineers for 1895, part 3, pages 2520–2525.

It is proposed to resume the work of removing obstructions above Lock No. 5, with the unexpended balance, $1,497.46, of the $1,500 appropriated by the act of June 3, 1896, as soon as the stream reaches a sufficiently low stage to permit the work to be done thoroughly and economically.

The stream is the only means of transportation in the section of country through which it flows, and its commerce, consisting almost wholly of timber floated down from the upper portions (some of which has been known to have been exported to Europe), has been as follows:

	Tons.		Tons.
1890	140,115	1894	106,412
1891	190,688	1895	179,240
1892	244,254	1896	105,212
1893	137,072	1897	176,169

July 1, 1896, balance unexpended	$1,500.00
June 30, 1897, amount expended during fiscal year	2.54
July 1, 1897, balance unexpended	1,497.46

(See Appendix F F 12.)

13. Operating and care of lock and dam in Little Kanawha River, West Virginia.—This lock and dam, known as No. 5 of the system, and

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located about 2 miles above Burning Springs, W. Va., or about 40 miles above Parkersburg, W. Va., was constructed under the additional project for improving Little Kanawha River, West Virginia, adopted in 1880. Lock No. 5 was opened to navigation on December 2, 1891, and has been in condition to be operated ever since that date, with the exception of a few days when it was closed for minor repairs. When the supply of water in the stream is more than the leakage through the four dams owned and operated by the Little Kanawha Navigation Company, below No. 5, 4 feet of slack-water navigation is afforded in this stream from its mouth at Parkersburg, W. Va., up to Creston, W. Va., about 50 miles above Parkersburg.

The character of the 4 locks and dams controlled by the navigation company below No. 5 and their condition are described in the Annual Report of the Chief of Engineers for 1895, Part III, pages 2520–2525.

The amount expended up to June 30, 1896, was $14,949.54, in operating the lock and making minor repairs to the lock, dam, and appurtenances.

The amount expended during the fiscal year ending June 30, 1897, was $2,349.03, in payment of the salaries of the lockmen and in making minor repairs to the lock, dam, and appurtenances.

The commerce that has passed Lock No. 5 since it was opened to navigation, and which has consisted almost wholly of timber, has been as follows:

	Tons.		Tons.
1890	140,115	1894	106,412
1891	190,688	1895	179,240
1892	244,254	1896	105,212
1893	137,072	1897	176,169

(See Appendix F F 13.)

LAKE RIVERS AND HARBORS.

IMPROVEMENT OF RIVERS AND HARBORS ON LAKE SUPERIOR.

This district was in the charge of Maj. Clinton B. Sears, Corps of Engineers. Division Engineers, Col. Henry M. Robert, Corps of Engineers, to May 7, 1897, and Col. J. W. Barlow, Corps of Engineers, since that date.

1. Harbor at Grand Marais, Minn.—This small natural basin was not originally of sufficient depth, nor was it adequately sheltered, either for commercial purposes or for use as a harbor of refuge; the approved project of 1879, therefore, proposed two breakwater piers, each 350 feet long from the east and west points of the bay, or one pier 700 feet long from the east point, and the dredging to a depth to accommodate the prevailing draft of vessels, which was 14 feet. Total estimated cost, $139,669.40. Up to the close of the fiscal year ending June 30, 1896, there had been expended on this work $129,773.99. With this sum, 350 feet of the east pier had been completed and the 16-foot anchorage area increased to 25 acres. The appropriation of June 3, 1896 ($3,000), was partly expended in dredging, under contract, thus completing this part of the project and giving a 16-foot anchorage area of 26 acres. The increment of commerce which has accrued since the improvement of this harbor began bears the ratio of 25 entrances and clearances (made by four tugs and five schooners), with 60 tons of cargo, valued at $6,000, in 1878, to 402 entrances and clearances (nearly all steamers), with 1,360 tons of cargo, valued at $114,198, in 1896. The improvement has cost $132,621.77. The value of the commerce of the harbor from 1878 to

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1896, both inclusive, is roughly estimated at $788,500. The unexpended balance of the last appropriation will be reserved as a repair fund, in case of accidents, until another appropriation becomes available.

July 1, 1896, balance unexpended	$3,576.01
June 30, 1897, amount expended during fiscal year	2,847.78
July 1, 1897, balance unexpended	728.23
Amount (estimated) required for completion of existing project	6,319.40
Amount that can be profitably expended in fiscal year ending June 30, 1899	22,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix G G 1.)

2. Harbor at Agate Bay, Minnesota.—This harbor, 27 miles east of Duluth, is a shipping port for iron ore, and when the breakwater piers are built will form a harbor of refuge.

The project for the improvement was adopted in 1887 and contemplates the erection of two piers projecting from the head lands of the bay and inclosing about 109 acres of water area. The eastern pier is to be 1,000 feet long and the western one 900 feet. Work upon the east pier was commenced in 1887, and at the close of work in November, 1891, 750 feet of it had been built. In 1893 200 feet of the west pier had been built. In 1895 and 1896 300 feet of riprap embankment was put in, and nearly 250 linear feet of the timber crib and superstructure, referred to in the last report, was built in continuation of the west breakwater. Of this timber work nearly 100 feet, in an incompleted state, was destroyed by a shipwreck against it in October, 1896. This will be replaced the present season under contract.

A contract, dated November 21, 1896, has been made for building 410 linear feet of riprap embankment up to a height of 20 feet below low-water datum. This contract is now in force, about 81 linear feet having been built. About $1,150 has been expended this spring in repairs to the east pier, renewing rotten decking and upper timbers.

The amount expended to June 30, 1896, was $108,102.70.

The commerce of this harbor has increased from 236,000 cargo tons, valued at $524,800, in 1885, to 1,905,559 cargo tons, valued at $2,650,000, in 1896. The total valuation of the commerce of this port for eleven years, 1885 to 1896, is roughly estimated at $20,528,000.

The arrivals and departures of vessels have increased from 174, with a registered tonnage of 295,800 tons, in 1885, to 1,982, with a registered tonnage of 4,360,000 tons, in 1896.

July 1, 1896, balance unexpended		$64,397.30
June 30, 1897, amount expended during fiscal year		12,897.00
July 1, 1897, balance unexpended		51,500.30
July 1, 1897, outstanding liabilities	$4,442.77	
July 1, 1897, amount covered by uncompleted contracts	24,124.61	
		28,567.38
July 1, 1897, balance available		22,932.92
Amount (estimated) required for completion of existing project		71,708.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		71,708.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix G G 2.)

3. Harbor at Duluth, Minn., and Superior, Wis.—This harbor has heretofore been reported on under the separate titles of Duluth, Minn.,

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and Superior, Wis. For history, etc., see last Annual Report, pages 2339–2352. The act of June 3, 1896, unified these harbors under above title and provided for continuous contracts for its improvement to the amount of $3,080,553.

This harbor consists now of the Duluth Canal, the Wisconsin Entrance, Superior Bay, Allouez Bay, St. Louis Bay, and St. Louis River to the limits of the cities of Duluth and Superior, about 20 miles from the original natural entry, which, before improvement, was obstructed by shifting bars, with but 9 feet of water over them. The bays were broad expanses of shallow water, averaging only 8 or 9 feet, except along the channel through them, where the depth was greater, but variable.

The previous projects have been practically completed, and have resulted in giving a good 16-foot navigation through the natural or Wisconsin Entry; through the artificial Duluth Canal; over the Duluth Basin, of 104 acres; along and parallel to the dock lines of Duluth and Superior, in Superior and St. Louis bays, and up the St. Louis River to New Duluth, near the head of navigation of the river, with well-defined channels from 85 to 300 feet in width.

The amount expended thereon up to the close of the fiscal year ending June 30, 1896, was $1,539,183.75. The improvement thus made is in excellent condition, and the expenditure has been amply justified by the immense commerce, which it has readily accommodated. (See commercial statistics hereafter.)

The expenditure during the fiscal year ending June 30, 1897, amounting to $48,319.22, has resulted in widening existing channels, in repairs to the piers, and in removing a few shoals due to temporary and abnormal causes.

The new project, authorized by the act of June 3, 1896, provides for the widening and deepening to 20 feet of existing channels; for a new 20-foot channel along Minnesota Point dock line; for new channels in Allouez Bay, for extensive turning and anchorage basins 20 feet deep at the junction of two or more channels; for widening the Duluth Canal, and for replacing with substantial structures of timber and monolithic concrete the piers at the Duluth Canal and the Wisconsin Entrance.

As the result of extensive advertising, continuous contracts for the dredging of about 26,000,000 cubic yards of material, at an average cost of a trifle less than 8 cents a cubic yard, have been made with Williams, Green & Williams, of Duluth, Minn., and Charles S. Barker, of Superior, Wis., thus strongly demonstrating the economic value of this method of contracting, the original estimate, based upon preceding experience, and including administration expenses, having been 15 cents a cubic yard.

The sundry civil act of June 4, 1897, appropriated $437,500, all of which will be expended under existing contracts for dredging and in purchasing land for the Duluth Canal and for the land under and adjacent to the southerly pier of the Wisconsin Entrance and in executing contracts to be made this fall and winter for the Duluth Canal piers.

The act of June 3, 1896, provides that not more than 25 per cent of the total contract allowance of $3,080,553 shall be expended in any one fiscal year, beginning July 1, 1897, unless the excess over 25 per cent was earned in the preceding fiscal year, but subsequent to July 1, 1897. Fifty per cent of $3,080,553 is $1,540,276. Deduct $437,500, already appropriated, and we have $1,102,776 as the amount which should be available on or before the end of the second fiscal year, June 30, 1899.

The city of Duluth has finally deeded to the United States all its

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remaining landed interests in and adjacent to the Duluth Canal, and condemnation proceedings for the balance of the land needed have been begun.

The lake commerce of this port—Duluth and Superior—during the last season of navigation amounted to over $112,000,000, as a very conservative valuation, and since the United States took charge of this harbor this commerce has amounted to over $900,000,000.

July 1, 1896, balance unexpended	[1]$58,975.25
Amount appropriated by sundry civil act approved June 4, 1897	437,500.00
	496,475.25
June 30, 1897, amount expended during fiscal year	48,319.22
July 1, 1897, balance unexpended	[2]448,156.03
July 1, 1897, outstanding liabilities	9,000.00
July 1, 1897, amount covered by uncompleted contracts	[3]1,991,500.00
Amount (estimated) required for completion of existing project	2,643,053.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	1,102,776.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix G G 3.)

4. Harbor at Ashland, Wis.—Ashland Harbor is located at the head of Chequamegon Bay, and originally had no protection from the waves which rolled into the bay nor from the waves generated within the bay itself by storms.

The approved project is for the construction of a pile, slab, and rock breakwater 8,000 feet long, and for dredging a channel along the shoal portion in front of the wharves of the city.

Seven thousand three hundred and sixty-three linear feet of the breakwater was completed in 1893, since which time no work of extension has been undertaken, subsequent appropriations having been used in strengthening and maintaining the old work and in dredging under a contract now in force.

The act of June 3, 1896, appropriated $27,000 for this harbor, and of this $9,000 has been expended in strengthening the older portion of the work by filling in between the piles with large rock, and the balance will be expended in dredging a channel parallel with and about 150 feet from the harbor line, which has been established at the request of the city council.

The total amount expended under approved project and in repairs to June 30, 1896, was $211,539.71.

The breakwater has a marked influence in improving the tranquillity of the harbor. Nine thousand three hundred and eight dollars and twenty-seven cents has been expended during the fiscal year ending June 30, 1897, and has resulted in materially strengthening the older portions of the breakwater, and in starting a channel along the shoaler part of the harbor-line front.

The commerce of this port consists principally of iron ore and lumber exported, and coal, mineral oil, and general merchandise imported.

The commerce has largely increased during the eleven years the harbor has been under improvement by the United States, the total commerce having a valuation, roughly estimated, of $300,000,000.

[1] $24 withdrawn from Treasury, account of transfer settlement by Third Auditor Treasury Department, July 5, 1890, Capt. J. B. Quinn's accounts.

[2] This work is carried on under a continuing contract.

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July 1, 1896, balance unexpended		$27,960.29
June 30, 1897, amount expended during fiscal year		9,308.27
July 1, 1897, balance unexpended		18,652.02
July 1, 1897, outstanding liabilities	$7,213.06	
July 1, 1897, amount covered by uncompleted contracts	9,500.00	
		16,713.06
July 1, 1897, balance available		1,938.96
Amount (estimated) required for completion of existing project		346,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix G G 4.)

5. Harbor at Ontonagon, Mich.—The entrance to Ontonagon River, which forms the harbor, had but 7 feet depth in 1867, at which time the project for securing 12 feet depth by building parallel piers on either side of the mouth, extending to the 18-foot curve of depth in Lake Superior, and dredging a channel between the piers, was adopted. The west pier was built to a length of 2,675 feet and the east pier to a length of 2,315 feet. This brought the outer end of the west pier very nearly out to the 18-foot curve of depth, as proposed. But this curve has advanced since, owing to the very considerable volume of sand carried into the lake by the river, and as it appears probable that the advance of the bar will keep pace with the extension of the piers unless a very considerable extension is made at once it does not appear that economic considerations would justify any further extension of the piers. It seems that better results will be secured by keeping the piers in repair and by dredging across the bar after each spring freshet.

As far as new work is concerned, the project may be said to be completed, and further expenditure will be needed only for keeping a 12-foot channel open by dredging, and for the repairs to the piers.

The $10,000 appropriation by the act of June 3, 1896, is being held for emergencies, such as accidents to the piers by storms, ice, etc., requiring renewals, and for dredging as soon as the ruling depth of 12 feet between the piers becomes materially impaired.

A fire in August, 1896, almost obliterated the town, destroying all its commercial industries, and most of the business and residence portions.

The total cost of the improvement to June 30, 1896, was $334,858.03. This has resulted in keeping open a good navigable 12-foot channel. Of late years the annual commerce has been roughly estimated at $1,000,000. The great fire, however, destroyed the principal commercial industry, the plant of the Diamond Match Company, and this company has, it is understood, determined not to rebuild. No appropriation is recommended for the next fiscal year.

July 1, 1896, balance unexpended	[1]$10,269.97
June 30, 1897, amount expended during fiscal year	590.61
July 1, 1897, balance unexpended	9,679.36
July 1, 1897, outstanding liabilities	8.06
July 1, 1897, balance available	9,671.30

(See Appendix G G 5.)

6. Waterway across Keweenaw Point from Keweenaw Bay to Lake Superior, Michigan.—This work was formerly reported on as the Portage Lake and Lake Superior canals, across Keweenaw Point, Michigan.

[1] Twenty-eight dollars deposited August 15, 1895, by United States Attorney John Power, account damages to Ontonagon piers by steamer *Owen Sound*.

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In accordance with the provisions of the river and harbor act of September 19, 1890, the United States purchased and assumed the charge and care of these canals on August 3, 1891.

The improvements consist of entrance piers at the harbor entrances on Lake Superior and Keweenaw Bay, canals and canal revetments, and dredged cuts and channel ways. There are no locks.

The approved project is for a 16-foot channel 70 feet wide, a renewal of the canal revetments, a reconstruction of the piers at the upper and lower entrances, and their extension to 30 and 20 feet of water, respectively, and ultimately a deepening of the channel to 20 feet, with a width of 120 feet.

The act of June 3, 1896, authorized continuing contracts to complete the above, except the 20 feet of depth, to the amount of $1,065,000.

As the 20-foot channel is not provided for by the above, an additional appropriation will be needed at some future time, after the above project has been completed.

The sundry civil act of June 4, 1897, appropriated $350,000 toward the continuing contracts. This will be expended under a contract dated April 13, 1897, for the construction of 2,800 linear feet of timber crib and superstructure breakwater pier at the Keweenaw entrance, work to be begun on or before May 1, 1898, and be completed by November 1, 1900, and to cost about $120,000; in making payments on two large stone and timber breakwater piers at the Lake Superior entrance, estimated to cost $450,000 and to be contracted for this fall, and in dredging to complete the 16-foot project.

During the past season of navigation, that of 1896, the commerce through this waterway has amounted to 902,000 tons of commodities, having an estimated value of $29,954,000, and 41,262 passengers, being an increase over the traffic of 1895 of 80,000 tons, $122,000 in value, and 16,453 passengers, respectively.

During the fiscal year ending June 30, 1897, $13,391.81 has been expended in dredging to complete the 16-foot channel, under a contract dated August 28, 1896, in general administration, and in preparing detailed plans and specifications for the continuous contracts.

Total amount expended on this work to June 30, 1896, $176,442.23.

July 1, 1896, balance unexpended		$53,557.77
Amount appropriated by sundry civil act approved June 4, 1897		350,000.00
		403,557.77
June 30, 1897, amount expended during fiscal year		13,391.81
July 1, 1897, balance unexpended		390,165.96
July 1, 1897, outstanding liabilities	$10,357.57	
July 1, 1897, amount covered by uncompleted contracts	143,886.22	
		154,243.79
July 1, 1897, balance available		235,922.17

Amount (estimated) required for completion of existing project	715,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	450,000.00
Additional amount required to secure a 20-foot depth	730,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix G G 6.)

7. Operating and care of waterway across Keweenaw Point from Keweenaw Bay to Lake Superior, Michigan.—The expenses of operating and care of this waterway for the fiscal year ending June 30, 1892, during which it was acquired by the United States, were paid by an appropriation of $10,000, made for the purpose by act of September 19, 1890.

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During the fiscal year ending June 30, 1897, $8,300 from the permanent indefinite appropriation of July 5, 1884, was expended in maintaining, by dredging, a practicable 16-foot stage of water, in superintendence and general operation of the canals, and in guarding against encroachments on the legally established harbor lines.

For the fiscal year ending June 30, 1898, $8,300 has been allotted by the Secretary of War.

(See Appendix G G 6.)

8. Harbor at Marquette, Mich.—Originally this harbor afforded no protection to vessels from easterly or northeasterly storms, and projects were approved for the construction of a breakwater composed of cribs filled with rock and projecting from the shore into the bay a distance of 3,000 feet. This breakwater was finished in 1894, practically as projected, but since its commencement extensive repairs have been made to the superstructure.

A project for a concrete superstructure was approved in February, 1890. Its estimated cost was $232,936.71.

Work on this concrete superstructure was begun in the spring of 1895, and up to June 30, 1896, 470 linear feet had been completed.

During the past fiscal year 390 linear feet of the main superstructure has been built, making the total length of completed work 860 linear feet. Partial work has been done over 140 linear feet more. It is intended to complete this 140 feet this season.

The breakwater has given complete protection to the harbor, and commerce has grown steadily until it amounts now to some $2,500,000 annually. The permanent maintenance of the breakwater by a durable concrete superstructure will do away with the frequent and expensive repairs incident to timber work.

The amount expended during the fiscal year ending June 30, 1897, was $22,045.45.

The total cost of the work to June 30, 1896, was $503,316.96.

July 1, 1896, balance unexpended	$30,240.80
June 30, 1897, amount expended during fiscal year	22,045.45
July 1, 1897, balance unexpended	8,195.35
July 1, 1897, outstanding liabilities	1,147.98
July 1, 1897, balance available	7,047.37

Amount (estimated) required for completion of existing project	198,936.71
Amount that can be profitably expended in fiscal year ending June 30, 1899	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix G G 7.)

9. Harbor of refuge at Presque Ile Point, Marquette Bay, Michigan.—This is a new work, authorized by the act of June 3, 1896. Marquette Bay is a small bay within the city limits of Marquette, north of Marquette proper, and distant 1½ miles therefrom.

A resolution of Congress, approved March 20, 1896, directed the Secretary of War to make a survey and submit an estimate for a breakwater in this bay. The results of this survey and estimate were published in House Doc. No. 318, Fifty-fourth Congress, first session.

By the act of June 3, 1896, $20,000 was appropriated for the improvement of this harbor.

The approved project is to build a breakwater 1,000 feet in length off Presque Ile Point.

After due advertisement a contract was made January 20, 1897, for

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the construction of 500 linear feet of a timber breakwater filled with stone. Work has been begun and two cribs have been placed. The work is to be completed by October 1, 1897.

July 1, 1896, balance unexpended		$20,000.00
June 30, 1897, amount expended during fiscal year		855.95
July 1, 1897, balance unexpended		19,144.05
July 1, 1897, outstanding liabilities	$183.00	
July 1, 1897, amount covered by uncompleted contracts	15,200.00	
		15,383.00
July 1, 1897, balance available		3,761.05

Amount (estimated) required for completion of existing project	30,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix G G 8.)

10. Harbor of refuge at Grand Marais, Mich.—Originally the entrance to this harbor was obstructed by a bar having but 9 feet depth of water upon it. The project for its improvement, adopted in 1881, has for its object a deep and safe channel into the harbor, making it a harbor of refuge. This object is to be attained by building parallel piers projecting into the lake and dredging out a channel between them, connecting the deep water of the lake with that of the harbor, and by closing up the natural entrance, some 5,700 feet in width, by a solid pile dike, driven with a slope toward the waves and strongly braced. The proposed length of each pier was 1,800 feet. The west pier has now reached a length of 1,406 feet and the east pier 1,153 feet.

An examination made in June, 1897, showed a least depth of 15 feet along the channel between the piers, but at the entrance this channel has a deviation to the east, owing to the encroachment of a bar making across the entrance from the west.

It is expected to have the pile dike finished this season, the work being done by the United States, three contractors in succession having failed to complete it.

The west pier will be extended 250 feet under a contract dated March 31, 1897, work to be done by November 1, 1897.

The total amount expended to June 30, 1896, was $271,661.92. The amount expended during the year ending June 30, 1897, was $14,088.91. The result has been the creation of a very safe and commodious harbor of refuge for vessels drawing 14 feet. It is expected that the completion of the project will make this safely accessible for vessels of 16 feet draft.

July 1, 1896, balance unexpended		$33,588.08
June 30, 1897, amount expended during fiscal year		14,088.91
July 1, 1897, balance unexpended		19,499.17
July 1, 1897, outstanding liabilities	$2,232.30	
July 1, 1897, amount covered by uncompleted contracts	13,135.00	
		15,367.30
July 1, 1897, balance available		4,131.87

Amount (estimated) required for completion of existing project	[1] 164,750.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix G G 9.)

[1] Does not include work on pile dike.

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EXAMINATION MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The preliminary examination of *harbor at Portwing, Wis.*, required by the act of June 3, 1896, was made by the local engineer, Maj. Clinton B. Sears, Corps of Engineers, and report thereon submitted November 27, 1896, through the division engineer, Col. Henry M. Robert, Corps of Engineers. It is the opinion of the local officer, concurred in by the division engineer, that this harbor is worthy of improvement by the General Government. The Chief of Engineers concurs in the views of these officers in so far as to advise the making of a survey of the harbor, estimated to cost $500, upon the results of which a more reliable opinion as to the extent of the improvement justified by the commerce involved can be formed. The report was transmitted to Congress and printed in House Doc. No. 113, Fifty-fourth Congress, second session. (See also Appendix G G 10.)

IMPROVEMENT OF RIVERS AND HARBORS ON WESTERN SHORE OF LAKE MICHIGAN.

This district was in the charge of Capt. George A. Zinn, Corps of Engineers. Division Engineers, Col. Henry M. Robert, Corps of Engineers, to May 7, 1897, and Col. J. W. Barlow, Corps of Engineers, since that date.

1. Menominee Harbor, Michigan and Wisconsin.—The survey made in 1871 with a view to the improvement of the entrance to the Menominee River showed that it had a depth of 5 feet. The first project for its improvement, adopted in 1871 and modified in 1874, provided for construction of two parallel piers 400 feet apart and for dredging between them, and had for its object a channel of navigable width, not less than 15 feet deep. In 1890 this was modified to secure a depth of 17 feet.

The amount expended up to June 30, 1896, was $222,029.20.

The original and modified projects have been completed, and except in spots the full depth of 17 feet below the datum plane has been secured. Annual dredging is required to remove the deposits of sand and other material brought in from the river and lake. The expenditure during the year resulted in rebuilding 400 linear feet of the piers above the water line.

The commercial statistics show the following arrivals and departures of vessels and quantity of lumber shipped in 1896: Arrivals of vessels, steam, 726; sail, 610; tonnage, 355,623; departures, steam, 729; sail, 573; tonnage, 349,514; lumber, feet B. M., 308,386,000.

Amount required for fiscal year ending June 30, 1899, for maintenance, is $5,500.

July 1, 1896, balance unexpended	$7,182.80
June 30, 1897, amount expended during fiscal year	3,285.28
July 1, 1897, balance unexpended	3,897.52
Amount that can be profitably expended in fiscal year ending June 30, 1899, for maintenance	5,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix H H 1.)

2. Menominee River, Michigan and Wisconsin.—The survey made in 1889 with a view to the improvement of the Menominee River showed a natural governing depth of about 5 feet, and that by private enterprise

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a tortuous channel had been dredged, about 50 feet wide and 14 feet deep, extending up the river a distance of 2 miles; a large portion of this channel was, however, entirely outside the limits of the present channel.

The original project of 1890 provided for the expenditure of $54,000 for dredging a channel 200 feet wide and 17 feet deep from Green Bay up the Menominee River as far as available funds would admit.

In 1892 additional funds were appropriated, and the project provided for making the 200-foot channel about 9,000 feet long, and from thence for a distance of 2,600 feet reducing its width to 100 feet. The act approved June 3, 1896, appropriated $15,000 and provided for the formation of a turning basin 600 feet long and 250 feet wide, also for extending the channel 425 feet, with a width of 75 feet. The total amount expended to June 30, 1896, was $80,565.56. This expenditure resulted in completing the original project and the modification of 1892, and the depth of 17 feet below the datum plane was secured. Shoaling has occurred in places, and redredging will be required from time to time.

The expenditures during the fiscal year ending June 30, 1897, have resulted in the formation of the turning basin, and work has been begun on the Wells street extension.

The commercial statistics for Menominee River are the same as for Menominee Harbor. (See Menominee Harbor report.)

Amount required for fiscal year ending June 30, 1899, for maintenance, is $5,000.

July 1, 1896, balance unexpended		$15,014.47
June 30, 1897, amount expended during fiscal year		3,890.61
July 1, 1897, balance unexpended		11,123.86
July 1, 1897, outstanding liabilities	$2,620.20	
July 1, 1897, amount covered by uncompleted contracts	6,190.47	
		8,810.67
July 1, 1897, balance available		2,313.19
Amount that can be profitably expended in fiscal year ending June 30, 1899, for maintenance. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		5,000.00

(See Appendix H H 2.)

3. Oconto Harbor, Wisconsin.—In its natural condition the channel at the entrance to the Oconto River was obstructed by a bar with less than 3 feet of water over it. Previous to 1881, when the first appropriation was made for its improvement, the citizens, by the construction of a small amount of slab pier and by dredging, had increased the depth to 4½ feet.

The part of the river between the mouth and the city of Oconto had a width of from 150 to 250 feet and a low-water channel depth of from 4 to 6 feet.

The project of improvement adopted in 1882 proposed to secure a 9-foot channel from Green Bay to the city of Oconto, a distance of 2 miles, by dredging and constructing piers, at an estimated cost of $150,000.

A modification adopted in 1897 provided for making Spies's mill the terminus of the improved channel, thereby abandoning 3,800 linear feet of the originally projected improvement.

The total amount expended up to June 30, 1896, was $73,103.23, resulting in the building and maintenance of two piers, the north pier 1,603 feet and the south pier 2,151 feet in length, the latter being the full length contemplated by the approved project, in the removal of

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453,416.4 cubic yards of material, and repairs to piers. In May, 1896, the governing depth of water from the harbor entrance to the shore line was about 8 feet, and there was about 7 feet in the river as far up as Spies's mill, a distance of 6,500 feet.

The expenditures during the fiscal year ending June 30, 1897, resulted chiefly in increasing depth of channel from 7 feet to 9 feet for a width of 70 feet from Green Bay to Spies's mill, by the removal of 48,060.4 cubic yards of material.

The commercial statistics show the following arrivals and quantity of lumber shipped in 1896: Arrivals of vessels, steam, 1,050; sail, 230; tow barge, 182; tonnage, 158,220. Lumber, feet B. M., 60,000,000.

Lumber, fence posts, and other forest products are the principal articles of export; $10 per thousand would be a fair valuation for the lumber.

The total value of exports by all ways of transportation in 1896 was reported to be $2,940,262; of imports, $1,968,340. It is estimated that $9,100 will be required for maintenance during the fiscal year ending June 30, 1899.

July 1, 1896, balance unexpended	$4,896.77
June 30, 1897, amount expended during fiscal year	4,741.89
July 1, 1897, balance unexpended	154.88
Amount (estimated) required for completion of existing project	37,610.00
Amount that can be profitably expended in fiscal year ending June 30, 1899, including $9,100 for maintenance	46,710.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix H H 3.)

4. Pensaukee Harbor, Wisconsin.—The original depth of water at the mouth of Pensaukee River was 2 feet, increased by private enterprise to from 8 to 10 feet for a width of 30 feet.

The project for the improvement of this harbor was adopted in 1883, and consisted of the construction of a single slab pier 2,500 feet long, in continuation of the pier built by private enterprise, and dredging a channel 11 feet deep and 100 feet wide on the south side of the pier.

The total amount expended up to June 30, 1896, was $15,000, resulting in the construction of 1,300 feet of the proposed extension of the pier and the dredging of 5,698 cubic yards of material, making a channel 25 feet wide and 11 feet deep.

Soundings taken in May, 1890, showed the governing depth at that time to be 3.8 feet. Some dredging was done by private parties in 1895.

There were no operations during the fiscal year ending June 30, 1897. Soundings taken April, 1897, showed an average depth of about 5 feet.

The appropriation of $1,000 by act of June 3, 1896, it is believed will afford sufficient funds for the maintenance of the pier and for dredging during fiscal year ending June 30, 1899.

July 1, 1896, balance unexpended	$1,000.00
July 1, 1897, balance unexpended	1,000.00

(See Appendix H H 4.)

5. Green Bay Harbor, Wisconsin.—The original channel from Green Bay into the Fox River was circuitous and narrow, with but 11 feet of water at its shoalest point. The original project for its improvement was adopted in 1866 and modified to secure greater depth in 1872, 1874, and 1892, and provides for a dredged channel 16,500 feet long, 200 feet wide, and 17 feet deep, passing through a revetted cut in Grassy Island.

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The project adopted in 1897 provided for increasing the width of entrance at north end of channel to 500 feet.

The Fox River below Depere, Wis., was included in the Green Bay appropriations of July 13, 1892, and June 3, 1896, and the project adopted in 1896 provides for the same depth as in the other channel.

The total amount expended up to June 30, 1896, was $345,899.02. This expenditure resulted in a dredged channel 16,500 feet long, with a depth of 15 feet for a width of 200 feet and a depth of 17 feet for a width of 100 feet, and in the construction of 1,325 linear feet of revetment at the sides of the cut through Grassy Island. This channel has been used by the largest class of vessels since October, 1895.

During the fiscal year ending June 30, 1897, 44,610 cubic yards of material was removed from the channel in Green Bay and 17,935 cubic yards from the Fox River below Depere. Work was in progress at both places at close of fiscal year.

The location of Green Bay is favorable for and it commands a large local trade. It is also the terminus of two railroads and of a transportation line from the lower lakes.

Commercial statistics for 1896.—Arrivals of vessels, 591; tonnage, 233,003. Exports, flour, 19,832 tons. Imports, coal, 170,311 tons. Values not given.

It is estimated that $6,600 will be required for maintenance during the fiscal year ending July 30, 1899.

July 1, 1896, balance unexpended		$26,703.48
June 30, 1897, amount expended during fiscal year		1,241.10
July 1, 1897, balance unexpended		25,462.38
July 1, 1897, outstanding liabilities	$4,293.99	
July 1, 1897, amount covered by uncompleted contracts	17,306.69	
		21,600.68
July 1, 1897, balance available		3,861.70
Amount appropriated by deficiency act of July 19, 1897		5,000.00
Amount available for fiscal year ending June 30, 1898		8,861.70
Amount (estimated) required for completion of existing project		[1] 32,200.00
Amount that can be profitably expended in fiscal year ending June 30, 1899, including $6,600 for maintenance		38,800.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, and of sundry civil act of June 4, 1897.

(See Appendix H H 5.)

6. Sturgeon Bay and Lake Michigan Ship Canal, Wisconsin.—In its natural condition, Lake Michigan was separated from Sturgeon Bay, an arm of Green Bay, by a neck of land about 1⅞ miles wide, having a maximum elevation above the lake level of about 28 feet. The Sturgeon Bay and Lake Michigan Ship Canal and Harbor Company, from 1872 to 1881, constructed across this neck a canal without locks or gates 7,200 feet long, 100 feet wide at water surface, and 14 feet deep, and in continuation of the canal dredged a channel in Sturgeon Bay 6,100 feet long of about the same dimensions as the canal. Of the 14,400 linear feet of canal banks, 8,437 feet was provided with pile revetments. The United States assumed possession of the canal April 25, 1893. The project of 1894 provided for an extension of the revetments, with an offset of 30 feet on each side, for fender piling, and for dredging to obtain a depth of 15 feet. The modification adopted in 1896 provided for a width of 250 feet between revetments for the westerly 1,000 feet of the canal and for a channel 200 feet wide in the bay; also for widen-

[1] Includes $30,000 for improvement of Fox River below Depere, Wis.

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ing the entire canal to 160 feet when the old revetment required rebuilding.

The total amount expended to June 30, 1896, was $99,661.24, of which amount $81,833 was for the purchase of the canal by the United States.

The governing depth in the channel June 30, 1896, was 15 feet.

The expenditures during the fiscal year ending June 30, 1897, were chiefly for extending the canal revetments 1,518 feet and dredging 30,420 cubic yards of material. There remain to be revetted on the north side of the canal 1,000 feet, and on the south side 2,300 feet. Work is now in progress on the south revetment.

The canal affords a considerable shortening of distance for many vessels over the natural outlet of Green Bay into Lake Michigan, avoids the dangers of the natural route, and makes Sturgeon Bay available and accessible as a harbor of refuge for vessels on Lake Michigan with a draft of less than 13 feet.

Commercial statistics for 1896.—Number of vessels passing through the canal, 4,031; tonnage, 1,558,148. Bound up, lumber, 519,436 tons; bound down, coal, 29,897 tons.

July 1, 1896, balance unexpended	$32,171.76
June 30, 1897, amount expended during fiscal year	16,088.26
July 1, 1897, balance unexpended	16,083.50
Amount (estimated) required for completion of existing project	63,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	63,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix H H 6.)

7. Operating and care of Sturgeon Bay and Lake Michigan Ship Canal, Wisconsin.—Under an allotment from the indefinite appropriation of July 5, 1884, for "operating and care of canals and other works of navigation," there has been expended during the fiscal year ending June 30, 1897, $16,280.12. The principal expenditures besides the payment of superintendent's and assistants' wages have been for repairs to canal revetments and for dredging. The slip near the eastern entrance to the canal, begun last year, was completed; about 350 linear feet of the south revetment was rebuilt above the water line; a large number of unserviceable water wales, cap timbers, and tie rods were replaced; the riprap protection along the harbor front was repaired with additional stone; the grounds adjacent to the canal buildings were graded and the buildings painted; the pile driver rebuilt, and 28,000 cubic yards of material dredged from the canal.

About 500 linear feet of the revetment is in a very dilapidated condition and needs immediate rebuilding.

Navigation through the canal was maintained until closed by ice December 22, 1896, and reopened March 27, 1897. No serious groundings occurred in the canal on account of an insufficient depth of water.

The water reached its lowest stage for the year on November 27, 1896, when it was 6.66 feet below high-water mark of 1838, and its highest stage at noon of June 17, 1897, when it was 3.26 feet below that point.

For commercial statistics, see report on Sturgeon Bay and Lake Michigan Ship Canal, Wisconsin.

(See Appendix H H 7.)

8. Sturgeon Bay Canal Harbor of Refuge, Wisconsin.—Before the construction of this harbor was undertaken the Lake Michigan entrance to the Sturgeon Bay and Lake Michigan Ship Canal was entirely unprotected from storms from northeast to southwest.

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The project of constructing a harbor of refuge at this point was adopted in 1873 and modified in 1879 and 1880. The modified project, as carried out and completed in 1884, consists of two piers, each 1,344 feet long, 850 feet apart at the shore line, protecting the lake entrance of the canal, and converging so as to make the harbor entrance 335 feet wide, inclosing an area of about 10 acres, with a depth of at least 17 feet.

The total expenditure at this harbor up to June 30, 1896, was $176,894.47. This expenditure resulted in the completion of the piers as projected and in a dredged channel 17 feet deep and 150 feet wide from the 17-foot contour in Lake Michigan to the canal entrance.

The expenditures during the fiscal year ending June 30, 1897, have been chiefly for redredging, which is still in progress. Minor repairs have been made to the piers and to the dredging plant.

The commercial statistics for this harbor will be found in report on Sturgeon Bay and Lake Michigan Ship Canal.

It is estimated that $5,500 will be required for maintenance during fiscal year ending June 30, 1899.

July 1, 1896, balance unexpended	$6,288.03
June 30, 1897, amount expended during fiscal year	2,304.3
July 1, 1897, balance unexpended	3,983.30
July 1, 1897, outstanding liabilities	35.33
July 1, 1897, balance available	3,947.97
Amount that can be profitably expended in fiscal year ending June 30, 1899, for maintenance	5,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix H H 8.)

9. Ahnapee Harbor, Wisconsin.—Previous to the improvement of this harbor the depth of water at the mouth of the Ahnapee River was only 3 feet.

The project of improvement adopted in 1875 and modified in 1884 provided for the formation of a small artificial harbor, connected with the lake by a channel 100 feet wide and 13 feet deep, formed by the construction of two piers extending to the 19-foot contour, with a 200-foot entrance channel between the pierheads.

By a modification of project adopted in 1897 further extension of the piers was abandoned.

The total amount expended up to June 30, 1896, was $174,862.41, resulting in the construction and maintenance of two piers, the north one 1,102 feet long and the south one 1,125 feet, and 225.6 linear feet of guide piling; in the removal of 30,528 cubic yards of rock and 147,643 cubic yards of sand and gravel, and in placing a double row of sheet piling along 352 feet of the north pier and 620 feet of the south pier. The rock was used for refilling and riprapping the piers.

The depth of water at the entrance was about 16½ feet, and 11 feet at the shore ends of the piers.

Of the area from which rock had been excavated one-third had the required depth of 13 feet, the remaining two-thirds an average depth of about 10 feet.

During the fiscal year ending June 30, 1897, $1,377.77 was expended for repairs to dredging plant and for care and superintendence of harbor.

Soundings taken in April, 1897, showed a channel between the piers 12 feet deep, with a least width of 75 feet, the depth at the entrance or between the pierheads being about 16½ feet.

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Commercial statistics for 1896.—Arrivals of vessels, 764; tonnage, 227,706. The exports and imports as reported for 1896 are 409,723 and 126,681 tons, respectively, by all ways of transportation, their approximate values being $846,246 and $827,380.63.

July 1, 1896, balance unexpended	$8,357.59
June 30, 1897, amount expended during fiscal year	1,377.77
July 1, 1897, balance unexpended	6,979.82
Amount (estimated) required for completion of existing project	13,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	13,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix H H 9.)

10. Kewaunee Harbor, Wisconsin.—The original entrance to the Kewaunee River was not more than 20 feet wide, with a depth of about 3 feet at its shoalest point, and was obstructed by submerged bowlders.

The project for its improvement adopted in 1881 provided for an artificial entrance channel 15 feet deep, located about 2,000 feet south of the river mouth, protected by two parallel piers 200 feet apart, extending from the shore to the 19-foot contour in the lake.

The total amount expended on this harbor up to the close of the fiscal year ending June 30, 1896, was $122,043.21, in addition to which the local harbor commissioners had expended $8,042.72. At that time 1,700 feet of the north pier and 1,625 feet of the south pier had been constructed, and there was a governing depth in the entrance channel of about 15 feet.

During the fiscal year ending June 30, 1897, $7,639.46 was expended, chiefly in dredging 74,825 cubic yards and in building a warehouse and dock on land donated to the United States by the city of Kewaunee. Soundings taken in May, 1897, showed a channel between the piers 15 feet deep. Under the contract now in force both piers will be completed to their projected length, and the funds available are sufficient to complete the project of improvement at a saving of about $50,000 over the original estimate.

Commercial statistics for 1896.—Arrivals of vessels, 800; tonnage, 465,507. By way of the harbor: Total approximate value of exports, $4,255,650; of imports, $3,142,640.

It is estimated that $6,600 will be required for maintenance during fiscal year ending June 30, 1899.

July 1, 1896, balance unexpended		$27,970.79
June 30, 1897, amount expended during fiscal year		7,639.46
July 1, 1897, balance unexpended		20,331.33
July 1, 1897, outstanding liabilities	$295.59	
July 1, 1897, amount covered by uncompleted contracts	18,000.00	
		18,295.59
July 1, 1897, balance available		2,035.74
Amount that can be profitably expended in fiscal year ending June 30, 1899, for maintenance		6,600.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix H H 10.)

11. Two Rivers Harbor, Wisconsin.—The original depth of the entrance to Two Rivers was from 3 to 4 feet. The project adopted in 1870 provided for a 13-foot channel between parallel piers 270 feet apart, extending from the shore line to the 19-foot contour in Lake Michigan. In 1875 the distance between the piers was reduced 40 feet. In 1897

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the project was modified by abandoning any further extension of the piers.

The amount expended thereon up to the close of the fiscal year ending June 30, 1896, was $209,377.57.

At that date the governing depth in the channel was about 12 feet. The dredging completed June 9, 1897, restored the channel to a depth of 13 feet for a width of 150 feet. The superstructure of the pile piers is in a dilapidated condition, and the sheet piling does not prevent the passage of sand through the piers into the channel.

Commercial statistics for 1896.—Arrivals of vessels, 714; tonnage, 239,400; exports, 8,776 tons; imports, 13,150 tons.

It is estimated that $19,800 will be required for maintenance during fiscal year ending June 30, 1899.

July 1, 1896, balance unexpended	$5,122.43
June 30, 1897, amount expended during fiscal year	4,859.92
July 1, 1897, balance unexpended	262.51
Amount that can be profitably expended in fiscal year ending June 30, 1899, for maintenance. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	19,800.00

(See Appendix H H 11.)

12. Manitowoc Harbor, Wisconsin.—The original depth of water at the mouth of the Manitowoc River was about 4 feet at the shoalest point. The original project, adopted in 1852, provided for a channel 13 feet deep between parallel piers 220 feet apart, and was completed in 1871. In 1881 a modification was adopted to secure 19 feet at the entrance and 15 feet at the shore line by pier extension and dredging and was completed in 1889. In 1890 a project was adopted for an exterior breakwater 400 feet long to afford protection to vessels entering the harbor during northeast storms. In 1896 a project was adopted for a channel 20 feet deep by extending the south pier and by dredging.

The amount expended thereon up to the close of the fiscal year is $349,460.39.

The exterior breakwater was completed in 1895; the project of 1896 is under construction. Soundings taken June 2, 1896, showed a 17-foot channel with a width of about 70 feet. In May, 1897, it was 18 feet deep and 110 feet wide as a result of dredging by United States Dredge No. 2 in July, August, and September, 1896.

Commercial statistics for 1896.—Arrivals of vessels, 1,104; tonnage, 610,251; exports, flour, 211,000 barrels. Total approximate value of imports by way of harbor, $2,750,000; exports, $21,700,000.

The establishment of car ferries between this point and points on the east shore and the increased depth of 20 feet in the river from dredging by the city of Manitowoc have materially increased the importance of this harbor.

July 1, 1896, balance unexpended		$51,020.11
June 30, 1897, amount expended during fiscal year		5,921.54
July 1, 1897, balance unexpended		45,098.57
July 1, 1897, outstanding liabilities	$406.08	
July 1, 1897, amount covered by uncompleted contracts	30,000.00	
		30,406.08
July 1, 1897, balance available		14,692.49

(See Appendix H H 12.)

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13. Sheboygan Harbor, Wisconsin.—The entrance to this harbor had originally a depth not exceeding 7 feet. The original project, adopted in 1866, had for its object a 13-foot channel between approximately parallel piers. This project was modified in 1873 to secure a deeper channel, and in 1881 by extending the piers to the 21-foot contour in the lake and dredging to a depth of 19 feet at the outer ends, gradually diminishing to 15 feet at their shore ends. In 1894 the project was modified to provide for a uniform width between the piers by reconstructing about 1,200 linear feet of the inner end of the south pier and removing the old pier, by dredging, etc.

The amount expended thereon up to the close of the fiscal year ending June 30, 1896, was $368,055.34.

At that date there remained about 100 feet of each pier to be built; 900 feet of the new pile pier had been built and some dredging done in the channel. In June, 1896, there was a channel 18 feet deep with a least width of 120 feet.

Work was begun on the pile pier to connect it with the old work May 20, 1897, and at the close of the fiscal year 100 feet had been finished and about 229 feet remained to be done. A portion of the old pier has been removed. The increased width in the finished part is already appreciated by vessel men.

Commercial statistics for 1896.—Arrivals of vessels, 1,042; tonnage, 613,340. By all ways of transportation: Exports, furniture, 8,000 tons; imports, coal, 200,000 tons.

July 1, 1896, balance unexpended	$26,393.57
June 30, 1897, amount expended during fiscal year	13,994.09
July 1, 1897, balance unexpended	12,399.48
July 1, 1897, outstanding liabilities	168.35
July 1, 1897, balance available	12,231.13
Amount (estimated) required for completion of existing project	26,600.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	26,600.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix H H 13.)

14. Port Washington Harbor, Wisconsin.—The natural channel at the mouth of the Sauk River was narrow, and at the shoalest point had a depth of 1 foot.

The original project for the improvement of this harbor was adopted in 1869, and provided for two parallel piers extending to 11 feet of water in Lake Michigan, and the excavation of an interior basin. This plan was modified in 1870 and again in 1876, and now provides for the excavation of two interior basins, with a combined area of 5¾ acres and a depth of 13 feet, and a channel of the same depth connecting the basins with the lake, between piers, extending to the 15-foot contour.

The amount expended thereon up to the close of the fiscal year ending June 30, 1896, was $188,563.33.

The piers were completed in 1893, and the rebuilding of the superstructure over the inshore ends of the piers, built in 1871, is now in progress. In May, 1896, the channel and basins had a depth of 13 feet. In May, 1897, the governing depth was 12 feet.

Commercial statistics for 1896.—Arrivals of vessels, 925; tonnage, 62,600; value of exports and imports by way of the harbor, $975,000 and $1,045,000, respectively.

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It is estimated that $4,400 will be required for maintenance during the fiscal year ending June 30, 1899.

July 1, 1896, balance unexpended	$5,973.17
June 30, 1897, amount expended during fiscal year	2,814.25
July 1, 1897, balance unexpended	3,158.92
July 1, 1897, outstanding liabilities	349.77
July 1, 1897, balance available	2,809.15
Amount that can be profitably expended in fiscal year ending June 30, 1899, for maintenance	4,400.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix H H 14.)

15. Harbor of refuge, Milwaukee, Wis.—Milwaukee Bay, in which the harbor of refuge is located, is protected by the coast from storms from all directions except from northeasterly to southeasterly, and, while the anchorage ground was good, vessels were in danger of dragging their anchors or of failing to effect an anchorage at the proper place. A Board of Engineers, in its report dated April 21, 1881, recommended a plan for a breakwater to inclose a portion of the bay, 417 acres in extent, beyond the 19-foot contour and about twice that area beyond the 13-foot contour. Work began in 1881, and up to June 30, 1896, there had been expended $608,846.98, resulting in the completion of 4,650 feet of substructure and 4,150 feet of superstructure and extensive repairs. The harbor is now used to a considerable extent as a shelter from easterly storms and its value will rapidly increase as the breakwater is extended.

A contract was made January 13, 1897, for the construction of 1,600 feet of breakwater, without superstructure, under the terms of item in the river and harbor act of June 3, 1896, for completing this improvement. Work was commenced April 24, 1897, by the depositing of stone for the foundation. The contractor has built a temporary wharf in the harbor of refuge and is prepared to push the work with great energy, and it is believed that he will complete the greater portion if not the whole of his contract this season. The interval between the shore end of the breakwater and the shore line was closed by a small crib pier. The intervals between the shore cribs were closed by wooden shutters and filled with riprap.

This work was authorized by the river and harbor act of June 3, 1896, to be carried on under the continuous-contract system, and the amount authorized by that act to be expended has been appropriated, but the carrying on of this work during many years under limited appropriations and the required immediate repair of damage to the breakwater from storms materially increased the actual cost of the work now in place. As a consequence the sum needed to complete the original project is greater than the original estimate, as fully explained in the annual reports of the local engineer officer for 1896 and 1897.

While the completion of the work permitted by the appropriation in the sundry civil act approved June 4, 1897, will furnish a breakwater which will be of much benefit to commerce, there will be required further appropriations of about $155,650 to fully complete it in accordance with modified plans and which the interests of commerce will justify. An estimate of this amount is presented for the consideration of Congress.

The commercial statistics are the same as for Milwaukee Harbor.

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July 1, 1896, balance unexpended		$22,415.11
Amount appropriated by sundry civil act approved June 4, 1897		168,737.91
		191,153.02
June 30, 1897, amount expended during fiscal year		17,467.46
July 1, 1897, balance unexpended		173,685.56
July 1, 1897, outstanding liabilities	$4,908.55	
July 1, 1897, amount covered by uncompleted contracts	163,829.36	
		168,737.91
July 1, 1897, balance available		4,947.65

Amount (estimated) required for completion of existing project..... 155,650.00
Amount that can be profitably expended in fiscal year ending June 30,1899 155,650.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix H H 15.)

16. Milwaukee Harbor, Wisconsin.—The original depth of water at the mouth of Milwaukee River was not more than 4½ feet. The original project, adopted in 1852, provided for a channel 13 feet deep between parallel piers located about 3,000 feet north of the natural mouth of the river. In 1868 this project was modified to secure a channel 19 feet deep by extension of piers and dredging.

The amount expended thereon up to the close of the fiscal year ending June 30, 1896, was $346,372.47.

The harbor piers were completed to their projected length in 1872. In April, 1896, there was a channel between the piers 100 feet wide and 19 feet deep.

During September and October, 1896, dredging, under contract, restored the channel to a width of 150 feet. A portion of the superstructure of the south pier was rebuilt.

Commercial statistics for 1896.—Arrivals of vessels, 5,481; tonnage, 3,866,884; revenue collected, $329,398.87.

Of the harbors on Lake Michigan this is the second in importance.

It is estimated that $14,000 will be required for maintenance during the fiscal year ending June 30, 1899.

July 1, 1896, balance unexpended	$7,052.89
June 30, 1897, amount expended during fiscal year	5,236.02
July 1, 1897, balance unexpended	1,816.87

Amount that can be profitably expended in fiscal year ending June 30, 1899, for maintenance..... 14,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix H H 16.)

17. South Milwaukee Harbor, Wisconsin.—The entrance to this harbor originally varied in depth from absolute closure to about 3 feet. The project of improvement adopted in 1896 provides for a channel 18 feet deep, 200 feet wide, between parallel piers, at an estimated cost of $138,000. There had been no expenditures by the United States at this harbor up to June 30, 1896. The piers were constructed by private parties, and are of no use to commerce in their present condition. A contract has been entered into for the extension of the north pier 180 linear feet, but no work has yet been done.

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Commercial statistics.—There are no available statistics of arrivals and departures of vessels.

July 1, 1896, balance unexpended	$5,000.00
June 30, 1897, amount expended during fiscal year	35.89
July 1, 1897, balance unexpended	4,964.11
July 1, 1897, amount covered by uncompleted contracts	4,500.00
July 1, 1897, balance available	464.11
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	133,000.00

(See Appendix H H 17.)

18. Racine Harbor, Wisconsin.—The entrance to this harbor originally varied in depth from absolute closure after storms to about 7 feet. The original project in 1842 or 1843 provided for a channel 13 feet deep between parallel piers. In 1866 the project was modified to provide a channel 16 feet deep and further modified in 1889 for 17 feet by pier extension and dredging.

The amount expended thereon up to the close of the fiscal year ending June 30, 1896, is $309,366.80.

At that date the north pier had reached its contemplated length and there remained 250 feet to be added to the south pier. In April, 1896, soundings showed a channel about 14.5 feet deep with a least width of 40 feet. In December, 1896, after the completion of the dredging by contract, there was a channel 17 feet deep. The south pier was extended 250 feet under contract, the work being completed June 26, 1897.

Commercial statistics for 1896.—Arrivals of vessels, 1,470; tonnage, 1,772,795. By all ways of transportation: Exports, 180,653 tons; approximate value, $32,260,140. Imports, coal, 165,840 tons; total approximate value of imports, $36,240,102.

It is estimated that $10,500 will be required for maintenance during the fiscal year ending June 30, 1899.

July 1, 1896, balance unexpended	$27,418.20
June 30, 1897, amount expended during fiscal year	12,447.21
July 1, 1897, balance unexpended	14,970.99
July 1, 1897, outstanding liabilities	11,211.29
July 1, 1897, balance available	3,759.70
Amount (estimated) required for completion of existing project	13,435.00
Amount that can be profitably expended in fiscal year ending June 30, 1899, including $10,500 for maintenance	23,935.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix H H 18.)

19. Kenosha Harbor, Wisconsin.—The original depth of water at the mouth of Pike Creek varied from nothing to 4 feet. The original plan of improvement was adopted in 1852 and had for its object a channel 13 feet deep, to be secured by constructing parallel piers and dredging between them. In 1889 the project was modified to secure 16 feet by pier extension and dredging. The river and harbor acts of September 19, 1890, and of June 3, 1896, required dredging in the basin just inside the harbor piers.

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The amount expended thereon up to the close of the fiscal year ending June 30, 1896, was $272,709.50.

At that date there remained to be constructed 150 linear feet of north pier and 250 linear feet of south pier, and there was a channel about 14 feet deep with a least width of 50 feet. From September, 1896, to April 21 the Racine Dredge Company removed 68,350 cubic yards from the channel and basin, giving a 16-foot channel 100 feet wide and 15 feet deep in the basin over an area of about 3 acres. The extension of the south pier 250 feet is now under way. To prevent the passage of sand through the south pier, 300 linear feet of sheet piling has been put in.

Commercial statistics for 1896.—Arrivals of vessels, 221; tonnage, 38,267. The approximate exports and imports by all ways of transportation, as reported by Mr. H. S. Van Ingen, were: Exports, 47,112 tons; value, $12,000,000. Imports, 169,995 tons; value, $8,000,000.

It is estimated that $24,250 will be required for maintenance during the fiscal year ending June 30, 1899.

July 1, 1896, balance unexpended	$26,597.91
June 30, 1897, amount expended during fiscal year	8,307.40
July 1, 1897, balance unexpended	18,290.51
July 1, 1897, amount covered by uncompleted contracts	13,000.00
July 1, 1897, balance available	5,290.51
Amount (estimated) required for completion of existing project	9,750.00
Amount that can be profitably expended in fiscal year ending June 30, 1899, including $24,250 for maintenance	34,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix H H 19.)

20. Waukegan Harbor, Illinois.—There was no navigable channel or natural harbor at this place. The project of improvement, adopted in 1880, had for its object the construction of an artificial harbor of sufficient capacity for local trade by inclosing a portion of Lake Michigan with pile piers, the entrance channel and inclosed area to be dredged to 13 feet. In 1882 this project was modified by reducing the area of the exterior basin, and by obtaining the additional space needed by dredging an interior basin connected by a narrow channel with the exterior basin. It has become necessary to abandon the interior basin because the land required was not secured for the purpose, and it is now practically impossible to secure possession. The present project provides for a basin 300 feet wide and 967 feet long.

The amount expended thereon up to the close of the fiscal year ending June 30, 1896, was $184,502.72.

At that date both piers had been completed to their projected length, and in April, 1896, there was a depth in the channel and basin of about 11 feet.

The dredging under contract during the last working season increased the depth from 11 feet to the projected depth of 13 feet, and it is expected that the entire project will be completed during the present season. Repairs to piers are now in progress.

Commercial statistics for 1896.—Exports, total tons, 99,448; imports, total tons, 279,957.

It is estimated that $3,000 will be required for maintenance during the fiscal year ending June 30, 1899.

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July 1, 1896, balance unexpended		$30,497.28
June 30, 1897, amount expended during fiscal year		14,021.52
July 1, 1897, balance unexpended		16,475.76
July 1, 1897, outstanding liabilities	$1,045.65	
July 1, 1897, amount covered by uncompleted contracts	5,721.88	
		6,767.53
July 1, 1897, balance available		9,708.23

Amount that can be profitably expended in fiscal year ending June 30, 1899, for maintenance 3,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix H H 20.)

21. Fox River, Wisconsin.—The Fox and Wisconsin rivers, separated at Portage City, Wis., by a distance of only 2 miles, one flowing into Lake Michigan, the other into the Mississippi River, were the early means of communication between those waters. In 1846 Congress granted to the State of Wisconsin a quantity of land for the purpose of improving the navigation of this route. By means of a board of public works the State began and carried on the improvement until 1853, when it was transferred to a private company. In 1872 the United States acquired possession of the property, with the exception of the water power, water-power lots, and personal property. The earliest project, that of 1848, called for canals 40 feet wide at bottom and 4 feet deep, with locks 125 feet long and 30 feet wide. This project was enlarged subsequently. The present project is that of a Board of Engineers submitted September 17, 1884, and modified May 14, 1886. It provides for deepening and widening the channel of the Fox River from Montello to Green Bay to 6 feet depth and 100 feet width, and from Portage to Montello to 4 feet depth, and for the renovation of 12 old locks.

The amount expended on the Fox and Wisconsin rivers from 1867 to the close of the fiscal year ending June 30, 1896, including $145,000 paid to the Green Bay and Mississippi Canal Company for its property, was $3,029,479.10, of which amount $364,479.10 was appropriated solely for and expended solely upon the Fox River since 1885.

The result of this expenditure upon the Fox River was the construction of 14 new stone locks; 15 dams, 2 of which are temporary; 12 canals; a head wall and feeder at the old first lock at Appleton; a lock house and warehouse at Appleton first lock; a wing dam and brush and stone for shore protection to the Portage Levee; a masonry waste-weir and culvert at head of combined locks; guard gates at head of Kaukauna Canal; rebuilding canal banks at Kaukauna; wing walls at Kaukauna fourth lock, and 587 linear feet of cement-laid rubble-core wall in canal banks of fourth and fifth levels; a channel 75 feet wide and 450 feet long, by blasting and drilling the rock bar below Depere Lock from 4 to 12 inches below the top of the lower miter sill; channel below Depere excavated to 12½ feet depth for a width of from 50 to 60 feet; deepened channels at mouth of Fond du Lac River, Neenah Channel, Fox River at head of Lake Butte des Morts, Grignon Rapids, below Little Chute and Rapide Croche locks, and in the canals and Upper Fox River.

The improvement of the Wisconsin River was abandoned in 1887.

The full depth of 6 feet was obtained from Oshkosh to De Pere, with the exception of one or two shoal places near Appleton and Menasha, and at the lower sill of the Menasha Lock, which has but 4 feet 6 inches over it at a low stage in the river; upon the Upper Fox the pro-

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jected depth has not yet been obtained. The expenditures during the fiscal year ending June 30, 1897, were for waste weir at Kaukauna second lock, for a roadway upon United States property at Appleton first lock, for fish ways in the Eureka, Berlin, and White River dams, for a small amount of dredging at the shoal places above mentioned, and for survey for harbor of refuge on the east shore of Lake Winnebago. Preparations were made for building a new crib dam with masonry abutments at Princeton and to remove the old brush dam.

The relative value of the commerce involved and the cost of the improvement can not be estimated.

Its principal effect so far has been to cause considerable reduction in freight rates to points in the Fox River Valley.

July 1, 1896, balance unexpended	$41,770.90
June 30, 1897, amount expended during fiscal year	6,174.47
July 1, 1897, balance unexpended	35,596.43
July 1, 1897, outstanding liabilities	1,799.59
July 1, 1897, balance available	33,796.84

Amount (estimated) required for completion of existing project	180,866.48
Amount that can be profitably expended in fiscal year ending June 30, 1899	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix H H 21.)

22. Operating and care of locks and dams on Fox River, Wisconsin.—Under an allotment from the indefinite appropriation for "Operating and care of canals and other works of navigation," there has been expended during the year ending June 30, 1897, the sum of $66,317.49. The principal expenditures in addition to pay of assistant engineer, receiver of materials, overseer, and 21 lock tenders, have been for rebuilding the Depere Lock, removing bars of Upper Fox by dredging, repairing and reenforcing Little Kaukauna Dam, building retaining walls below right abutment of Depere Dam, below Kaukauna first lock, above Combined Locks, and repairing locks, dams, boats, and dredges. A detailed statement appended to the report of the local engineer officer in charge shows the items of expenditure.

Navigation was closed November 14, 1896, and reopened April 10, 1897, excepting at Depere, opened on the 16th, and at Portage Canal, opened on the 23d. The water in Lake Winnebago and the Lower Fox has been well maintained at the crests of the dams throughout the year with few exceptions—the first full year that this has occurred.

For commercial statistics, see report on Fox River, Wisconsin.

(See Appendix H H 22.)

23. Removing sunken vessels or craft obstructing or endangering navigation.—Wreck of barge Sumatra, in Milwaukee Bay, Wisconsin.—On September 30, 1896, the barge *Sumatra*, loaded with railroad rails, foundered about three-fourths of a mile east by south of the entrance to Milwaukee Harbor, in 33 feet of water, and formed a dangerous obstruction to navigation.

On December 10, 1896, all of the cargo except 40 railroad rails had been removed, and the wreck abandoned by the owners and parties interested.

On February 18, 1897, such parts of the wreck as were obstructions to navigation were removed by the United States at a total cost of $350, leaving an unobstructed depth of 28 feet over the site of the wreck.

(See Appendix H H 23.)

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SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The surveys of the following localities, required by the act of June 3, 1896, were made by the local engineer, Capt. Geo. A. Zinn, Corps of Engineers, and reports thereon submitted through the division engineer, Col. Henry M. Robert, Corps of Engineers:

1. Survey of harbor at Menominee, Michigan and Wisconsin, with a view of obtaining a 20-foot depth of water.—Captain Zinn submitted report of survey November 30, 1896. Two plans of improvement are presented, one by pier extension and dredging and the other by dredging only. In the opinion of the local officer, the better method of obtaining a 20-foot channel at Menominee Harbor is to dredge the channel to that depth from the river to the 20-foot contour in Green Bay without extension of the piers. The estimated cost of the work proposed, according to this plan, is $18,920. The division engineer concurs in recommending the adoption of this second, or dredging, plan for the further improvement of this harbor. He states that after the 20-foot channel has been obtained it will probably cost about $3,000 annually to maintain it. The report was transmitted to Congress and printed in House Doc. No. 86, Fifty-fourth Congress, second session. (See also Appendix H H 24.)

2. Survey of harbor at Ahnapee, Wis.—Captain Zinn submitted report of survey December 31, 1896. He states that the harbor facilities at Ahnapee may be increased at three places, but, for the reasons mentioned in his report, he is of the opinion that nothing more than the completion of the present project and its maintenance should be undertaken by the United States, as this, when completed, will, in his judgment, fulfill all the requirements of a harbor at Ahnapee. The completion of the present project is estimated to cost $18,000. The report was transmitted to Congress and printed in House Doc. No. 172, Fifty-fourth Congress, second session. (See also Appendix H H 25.)

3. Survey of Sheboygan Harbor, Wisconsin, with a view of obtaining 21 feet.—Captain Zinn submitted report of survey January 27, 1897. The plan of improvement presented for securing a depth of 21 feet includes the completion of the present project, which provides for securing and maintaining a channel depth of 19 feet, and a continuation of the means of improvement heretofore employed at this place, i. e., pier construction and dredging. The estimated cost of the work required is $75,000 in addition to the funds now available. The local officer is inclined to believe that the interests of commerce justify the proposed improvement at Sheboygan, and his views are concurred in by the division engineer. The report was transmitted to Congress and printed in House Doc. No. 327, Fifty-fourth Congress, second session. (See also Appendix H H 26.)

4. Survey of Milwaukee Harbor, Wisconsin, with a view to obtaining a channel 21 feet deep.—Captain Zinn submitted report of survey November 23, 1896. The proposed method for obtaining a 21-foot channel at the harbor of Milwaukee is to dredge the present channel to the width of 225 feet between the piers and 600 feet wide from the pierheads to the 21-foot contour in Lake Michigan. It is estimated that this plan of improvement will cost $12,000 for original work and about $3,000 per year for maintenance. The report was transmitted to Congress and printed in House Doc. No. 61, Fifty-fourth Congress, second session. (See also Appendix H H 27.)

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5. Survey of harbor at Racine, Wis., with a view to obtaining a channel 21 feet deep.—Captain Zinn submitted report of survey January 27, 1897. To secure a 21-foot channel in the manner proposed in this report will cost, it is estimated, $51,650. The local officer states that the commerce of Racine is large and justifies, in his opinion, the proposed improvement. This opinion is concurred in by the division engineer. The report was transmitted to Congress and printed in House Doc. No. 326, Fifty-fourth Congress, second session. (See also Appendix H H 28.)

6. Survey of harbor at Kenosha, Wis., with a view to obtaining a channel 21 feet deep and basin 20 feet deep.—Captain Zinn submitted report of survey January 26, 1897. The harbor at Kenosha is now in course of improvement by the United States, under a project which provides for securing and maintaining a channel depth of 16 feet. Two plans are presented for obtaining the increased channel depths contemplated in the act of 1896, at an estimated cost of $87,000 and $125,000, respectively. In the opinion of the local officer, however, the present interests of the commerce involved do not justify the proposed improvement. This opinion is concurred in by the division engineer. The report was transmitted to Congress and printed in House Doc. No. 328, Fifty-fourth Congress, second session. (See also Appendix H H 29.)

IMPROVEMENT OF CHICAGO AND CALUMET HARBORS AND CHICAGO AND ILLINOIS RIVERS, ILLINOIS, AND CALUMET RIVER, ILLINOIS AND INDIANA; ILLINOIS AND MISSISSIPPI CANAL, ILLINOIS.

This district was in the charge of Maj. W. L. Marshall, Corps of Engineers, having under his immediate orders Lieut. Henry Jervey, Corps of Engineers. Division Engineers, Col. Henry M. Robert, Corps of Engineers, to May 7, 1897, and Col. J. W. Barlow, Corps of Engineers, since that date.

1. Chicago Harbor, Illinois.—The present project was adopted in 1870 and modified in 1878, and contemplated—

(*a*) The formation of an outer harbor or basin by inclosing a portion of Lake Michigan just south of the entrance to Chicago River by breakwaters, and dredging the same, for the purpose of increasing the harbor facilities of Chicago.

(*b*) The construction of an exterior breakwater in deep water in Lake Michigan north of the entrance to Chicago River and about 1 mile distant therefrom, to shelter the approaches to the river and outer harbor and to form a harbor of refuge near the southern end of Lake Michigan.

(*c*) To keep the entrance to Chicago River dredged for the passage of vessels navigating Chicago River as far as to the original shore line of Lake Michigan at or near Rush Street Bridge.

This project was extended to include the improvement of Chicago River for vessels drawing 16 feet of water by the river and harbor act of June 3, 1896, which extended project is now reported separately.

There has been expended upon this project up to June 30, 1897, $1,800,571.77, including $25,000 allotted from the appropriation of August 18, 1894, for dredging Chicago River, of which amount $3,645.70 was expended for dredging from the mouth of the river to Rush Street Bridge, and $21,354.30 applied to dredging the river from its mouth to the Stock Yards, on South Branch, and to Belmont avenue, on the North Branch.

Originally the mouth of Chicago River was obstructed by a sand bar, across which a varying depth of water existed, suitable for light-draft

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navigation. The piers at the mouth of the river have been projected beyond this bar, and at present there exists a channel sufficient for vessels drawing 17 feet of water.

All of the work under the projects of 1870–1878 has been done, except dredging the outer basin, and the piers, breakwaters, and channel have been maintained in good order.

The piers at the entrance to Chicago River, the exterior breakwater, and the breakwaters of the outer basin are now in excellent condition, except about 500 linear feet of superstructure over the southerly breakwater, outer basin, which will soon need rebuilding. Some stone filling is also needed in this breakwater.

All of the old piers near the mouth of Chicago River now within the shore line have been practically abandoned by the United States as forming part of the bulkheads or wharves of Chicago River, except that portion of the south pier forming the north limit of the Illinois Central Railroad Docks.

The outer basin continues to fill in, and in its present condition is useless as a roadstead except for small vessels drawing less than 12 feet of water.

To give 16 feet of water in this basin 500,000 cubic yards of dredging is required, and to give 18 feet below Chicago city datum or 20 feet below the mean level of Lake Michigan 1,500,000 cubic yards of dredging is required.

It would be now advantageous to do this work.

A bulkhead has been constructed by the local authorities along the dock line in the outer harbor; and the area between this dock line and the shore line, except a small yacht basin at the southern end of the harbor, is now being filled in for a public park.

COMMERCIAL STATISTICS.

Amount of revenue collected during fiscal year, $5,050,370.61.

Arrivals and clearances of vessels, Chicago Harbor.

	Arrived.		Cleared.	
	Number.	Tons.	Number.	Tons.
Steam	5,380	4,278,093	5,339	4,196,117
Sail	1,879	630,160	1,845	623,615
Total	7,259	4,908,253	7,184	4,819,732

Receipts and shipments by lake at Chicago, Ill., during calendar year 1896.

Receipts.	Tons.	Shipments.	Tons.
Coal	1,146,363	Flour	156,832
Iron, iron ore, and nails	74,888	Grain	2,044,545
Fish	2,471	Lead	36,949
Lumber, wood, etc	1,753,052	Lard	30,547
Flour, salt, sugar, sirup	301,207	Meats	3,968
Cement, plaster, etc	92,914	Sugar and sirup	35,872
Potatoes	6,734	Coffee, tea	3,974
Green fruit	68,329	Steel rails, etc	2,325
Coffee	11,296	Iron and nails	3,210
Grain	3,835	Hay	11,765
Liquors	10,977	Coal	270
Miscellaneous merchandise	300,940	Oil and oil cake	20,542
		Miscellaneous merchandise	223,358
Total	3,773,006	Total	2,574,157

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July 1, 1896, balance unexpended	[1] $33,602.52
June 30, 1897, amount expended during fiscal year	23,544.13
July 1, 1897, balance unexpended	10,058.39

(See Appendix I I 1.)

2. Chicago River, Illinois.—This river as far as its navigable water extends is entirely within the limits of the city of Chicago, Ill. Originally a sluggish stream, navigable for vessels that could pass the bar at its mouth, it is now one of the most important commercial or navigable nontidal waters of its length in the world. Prior to the act of June 3, 1896, no work had been done for the improvement of its navigation by the United States. The present project, inaugurated by Congress under the act of June 3, 1896, as modified by the act of June 4, 1897, contemplates the improvement of the river by dredging and minor changes in docks and dock lines to admit passage by vessels drawing 16 feet of water.

The depth adopted and authorized has been absolutely determined by the crown of the Washington and La Salle street tunnels, beyond which depth it is again limited to 18 feet by the Van Buren Street Tunnel.

The dimensions of vessels, other than depth of hold and draft, is further limited by the bridges, bends, and width between docks.

The river and harbor act of August 18, 1894, allowed $25,000 from the appropriation made for the improvement of Chicago Harbor to be applied to the improvement of Chicago River between the mouth of the river and the junction of the two branches, of which amount $3,645.70 was expended in the preceding year ending June 30, 1896, in dredging to 18 feet depth as far as to Rush Street Bridge. Since the passage of the act of June 3, 1896, the balance of this amount has been transferred to the Chicago River work.

Up to the close of the fiscal year ending June 30, 1897, there has been expended in dredging Chicago River $49,475.21, including the $25,000 allotted as above stated, as a result of which expenditure the river has been dredged to a depth of 17 feet below Chicago city datum from the mouth of the river to Ashland avenue on the South Branch, and to Thirty-third street on the South Fork, South Branch, a distance of about 5½ miles, and to near North avenue on the North Branch, including about two-thirds of the Goose Island Cut-off, a total length in this branch of about 2¾ miles.

During the past fiscal year under contract with the lowest responsible bidders, made under the conditions of the act of June 3, 1896, 507,577 cubic yards of earth has been taken from the river, of which 258,966.7 cubic yards has been dredged from the South Branch and 248,610.3 from the North Branch, leaving about 800,000 cubic yards of material still to be removed under these contracts, which are "continuing."

The sundry civil act of June 4, 1897, allows work to be done in widening the river by minor changes in dock lines, in addition to dredging. A project for this work is now being prepared for submission to the Secretary of War.

The restricted channel in Chicago River is extremely hampering to all interests dependent upon commerce by water, but no practical plan

[1] Fifty thousand dollars appropriated by act of June 3, 1896, for "improving Chicago River," and which was included in statement for "Chicago Harbor" in last Annual Report, has been deducted from previous statement and is not included in this amount.

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of radical improvement in the condition of the channel has yet been proposed.

The dredging, as far as authorized by the act of June 3, 1896, will probably have been completed by September 1, 1898, at present rate of work.

The funds asked for are contingent upon the adoption of a project for widening the river under the provisions of the act of June 4, 1897.

For commercial statistics, see preceding report on Chicago Harbor improvement.

July 1, 1896, balance unexpended (act June 3, 1896)		$50,000.00
Amount appropriated by sundry civil act approved June 4, 1897		113,000.00
		163,000.00
June 30, 1897, amount expended during fiscal year		24,475.21
July 1, 1897, balance unexpended		138,524.79
July 1, 1897, outstanding liabilities	$100.00	
July 1, 1997, amount covered by uncompleted contracts	118,598.49	
		118,698.49
July 1, 1897, balance available		19,826.30

Amount (estimated) required for completion of existing project..... 537,000.00
Amount that can be profitably expended in fiscal year ending June 30,1899 400,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix I I 2.)

3. Calumet Harbor, Illinois.—This harbor is known on the Great Lakes as South Chicago Harbor.

This improvement was designed to furnish a safe and practicable entrance to Calumet River and the port of South Chicago by the construction of parallel piers 300 feet apart, projecting from the shore into Lake Michigan, and by dredging between them.

The work began in 1870 and all the projected work had been accomplished for 16-foot draft prior to June 30, 1896, resulting in the construction of 3,640 linear feet of north pier and 2,020 linear feet of the south pier, and the securing and maintaining a channel 16 feet deep and of suitable width from similarly deep water in Lake Michigan to the Calumet River at the roots of the piers, at a cost of $454,488.53. The work included also 476,564 cubic yards material dredged, increasing the depth in the channel from 7 to 16 feet.

On this date, June 30, 1896, it may be considered that the original project for this locality was terminated and completed.

On June 30, 1895, a further project based upon a survey ordered by the river and harbor act of August 18, 1894, was submitted for the further improvement of this harbor, contemplating the extension of the south pier 1,200 linear feet, of the north pier 500 linear feet, and the dredging of a channel to 20 feet depth at low water, all at an estimated cost of $154,550. (See Annual Report of Chief of Engineers for 1895, p. 2771.)

Later, upon a further call of this office, the local engineer, under date February 21, 1896, submitted a report presenting a plan for improvement of both the inner and outer harbors. The estimated cost of this improvement was $1,134,830. (See Annual Report of Chief of Engineers for 1896, p. 2584, and following page.)

The act of June 3, 1896, in appropriating for Calumet Harbor includes the amended project of June 30, 1895, but in appropriating for the Cal-

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umet River adopts the project of February 21, 1896, in so far as relates to the 20-foot channel in harbor and river.

The projects conflict in so far as that if the project of February 21, 1896, be adopted, the north pier need not be extended at all, and the south pier be extended only 800 linear feet instead of 1,200 linear feet.

In view of this fact the money appropriated by the act of June 3, 1896, has been expended on that part of the two projects common to both, i. e., in extending the south pier 800 linear feet and in dredging the harbor to 20 feet depth as far as to the junction with a similar channel authorized by the same act in Calumet River.

Both works, namely, the extension of the south pier 800 linear feet and dredging the channel from deep water in the lake to a similar depth of 20 feet in Calumet River, have been done during the past fiscal year under contracts with the lowest responsible bidders. Two hundred thousand six hundred and sixty-nine cubic yards of material was removed by dredging; 808,966.6 feet B. M. hemlock timber; 281,696 feet B. M. pine timber; 20,917 feet B. M. oak plank; 320 pine piles and 13 white oak piles; 82,056 pounds drift bolts; 6,480.4 pounds screw bolts; 2,205 pounds spikes; 222 pounds chain; 819 pounds boiler iron; 2,326.12 cords of stone, and 4,219.1 cubic yards dredging for crib foundations were done on and placed in the work.

On account of the favorable bids received, the work was done at less cost than estimated, and by authority of this office a contract with the lowest responsible bidder was entered into June 14, 1897, for the rebuilding and repair of superstructure over 500 linear feet of the north pier at its outer end, and this work is now in progress.

The work is now in good condition, except about 500 linear feet of superstructure and the light revetment west of the Illinois Steel Company's slip, both of which need rebuilding.

The construction of the outer breakwater and the dredging of the harbor of refuge, as given in the project of February 21, 1896, is much needed.

The estimates made herein are based on the supposition that the greater of the two projects is to be carried out. If the lesser be in question, work would be done that is entirely unnecessary under the greater scheme, and the less project will not meet the conditions of constant shoaling in advance of the piers.

The greater project, contemplating an outer protecting breakwater and dredging in the sheltered area, is a necessity that must sooner or later be met and satisfied.

If, however, the lesser project is to be carried out, $79,550 is required under the project of June 30, 1895, to complete the work under that project.

COMMERCIAL STATISTICS.

Amount of revenue collected at nearest port of entry (Chicago) during the fiscal year, $5,050,370.61.

Arrivals and clearances of vessels at Calumet Harbor.

	Arrived.		Cleared.	
	No.	Tons.	No.	Tons.
Steam	690	1,011,996	764	1,104,486
Sail	460	524,838	494	546,056
Total	1,158	1,536,834	1,258	1,650,542

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Receipts and shipments by lake at South Chicago during calendar year 1896.

Receipts.	Tons.	Shipments.	Tons.
Coal	213,937	Steel rails	108,206
Cement and plaster	55,470	Coal	10,616
Iron and iron ore	1,212,903	Iron and nails	7,726
Salt	168,037	Oil	29,710
Lumber, etc	186,499	Grain	913,887
Miscellaneous	56,430	Miscellaneous	10,303
Total	1,893,276	Total	1,080,448

Comparison of receipts and shipments at South Chicago, Ill., for four calendar years 1893, 1894, 1895, and 1896.

	Tons.
1893	903,379
1894	1,436,897
1895	2,857,750
1896	2,973,724

An increase of about 330 per cent in 1896 over 1893.

July 1, 1896, balance unexpended		$82,911.47
June 30, 1897, amount expended during fiscal year		58,242.75
July 1, 1897, balance unexpended		24,668.72
July 1, 1897, outstanding liabilities	$56.81	
July 1, 1897, amount covered by uncompleted contracts	9,153.93	
		9,210.74
July 1, 1897, balance available		15,457.98

Amount (estimated) required for completion of existing project of February 21, 1896	1,009,830.00
Amount (estimated) required for completion of existing project of June 30, 1895	79,550.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	300,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix I I 3.)

4. Calumet River, Illinois and Indiana.—The project for the improvement of this river, adopted by Congress in 1883, contemplated securing a channel 200 feet in width and 16 feet in depth below low water in Lake Michigan, from the mouth of Calumet River at Calumet Harbor, Illinois, to one-half mile east of Hammond, Ind., with a view to increasing the facilities for handling the commerce of this region and also aid in providing means for the better accommodation of much of the commerce of Chicago River, which river was and still is much crowded.

The original depth in Calumet River varied between 6 and 10 feet.

Following a report on a survey of Calumet Harbor, Illinois, published as House Doc. No. 277, Fifty-fourth Congress, first session, also published in Annual Report Chief of Engineers, 1896, page 2583, the project has been modified by the river and harbor act of June 3, 1896, so far as to allow the channel for 2 miles southward from the mouth of the river to be dredged to 20 feet depth.

This modification increases the estimated cost of the improvement by $51,700.

Since the improvement begun in 1889, there has been dredged a channel, measured from the harbor southward, to the full width of 200 feet and depth of 16 feet, 19,518 feet in length, except that over a short portion where rock was encountered the width was reduced to 85 feet, 9,000

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cubic yards or less of rock remaining to be removed to secure full width and depth over this short stretch.

Under this 16-foot project 1,767,220 cubic yards material was removed prior to June 30, 1896, from the channel "below the forks" of the Calumet. In addition there has been removed 248,516 cubic yards of material from the channel between the forks and one-half mile east of Hammond, Ind., in an effort to secure a practicable channel 10 feet deep and 60 feet wide, resulting in failure, due to rapid refilling of channel by slaughterhouse refuse, sewage, and other filth.

The amount expended by the United States on this original project prior to June 30, 1896, was $291,842.07, of which $248,715.91 has been expended "below the forks" and $43,126.16 for work between the forks and one-half mile east of Hammond, Ind.

The river and harbor act of 1896 authorized dredging the channel to 20-foot depth for 2 miles southward from the mouth, and under this supplementary and restricted project during the last fiscal year there has been 222,400 cubic yards of material removed under contract with the lowest responsible bidder for the work, completing the channel 20 feet deep a distance of about 1¼ miles.

A winding or turning basin 20 feet deep, of sufficient dimensions for the largest lake vessels yet constructed, was also dredged at the first cut-off above the mouth of the river.

The amount appropriated by the act of June 3, 1896, will be sufficient to dredge the channel to the 2-mile limit and provide the basin named at somewhat less cost than estimated February 26, 1896, due to the favorable terms secured for the work.

Similar winding or turning basins should be provided at intervals of from 1 to 2 miles along the river, to avoid in future the restrictions now imposed in other lake harbors within the shore lines.

There is at present a good 20-foot channel from the harbor to the Chicago Shipbuilding Company's dock; thence to One hundred and sixth street there is a good channel 16 to 17 feet in depth, which will soon be increased to 20 feet. Above this point the 16-foot channel has deteriorated by filling in until there is now less than 16 feet. No work has been done under the regular 16-foot project above One hundred and eighteenth street.

The improvement of the river has been followed by a remarkable development of commerce, which now exceeds 3,000,000 tons per annum, or about one-third that of Chicago Harbor, the most important on the Great Lakes.

July 1, 1896, balance unexpended		$58,157.93
June 30, 1897, amount expended during fiscal year		25,494.21
July 1, 1897, balance unexpended		32,663.72
July 1, 1897, outstanding liabilities	$100.00	
July 1, 1897, amount covered by uncompleted contracts	22,433.03	
		22,533.03
July 1, 1897, balance available		10,130.69
Amount (estimated) required for completion of existing project		700,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		250,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix I I 4.)

5. Illinois River, Illinois.—The present project was adopted in 1880, and contemplates the extension of the slack-water improvement begun

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by the State of Illinois from Copperas Creek Locks to the Mississippi River, a distance of 135 miles.

The project includes the construction of two locks, 350 feet long between miter sills, 75 feet width of chamber, with 7 feet of water over sills at low-water level of 1879, and dredging the channel where necessary to obtain 7 feet depth at low water in the pools thus created.

The two locks and dams are completed and in use. One is situated at Kampsville, 31 miles above the mouth of the Illinois River, the other at Lagrange, 79 miles above the mouth of Illinois River.

The ultimate object of the improvement is the construction of a waterway from the southern end of Lake Michigan to the Mississippi River of sufficient capacity to accommodate large-sized Mississippi River steamboats and for military and naval purposes.

The State of Illinois, aided by the United States, has executed part of the project by the construction of two locks of the dimensions given—one at Henry and one at Copperas Creek—completing, except dredging, that part of the improvement between Lasalle, Ill., and the mouth of Copperas Creek, a distance of about 90 miles.

In executing this work the United States has expended, up to June 30, 1897, $1,344,090.62, including $25,000 from the appropriation of August 11, 1888, for surveys, and excluding $62,359.80 expended upon a foundation for Copperas Creek Lock, afterwards completed by the State of Illinois.

An additional amount of $747,747 was expended by the State of Illinois at Henry and Copperas Creek locks and dams.

During the fiscal year ending June 30, 1897, the following work was done:

A new hull was built for Dredge No. 1; a new hull for a quarter boat for dredge crew; two new steam dredge tenders; and the channel of the river dredged at Devils Elbow, head of Grand Island, mouth of Sugar Creek, and at mouth of Macoupin Creek, and extensive repairs made to the plant. The plant had so deteriorated that the floating portion was practically rebuilt, the necessity for which limited the time of possible effective work of dredging. Fifty-one thousand nine hundred and thirty-one cubic yards was removed from the bars above named.

The channel of the Illinois River is becoming the best of all the tributaries of the Mississippi, and it is believed that the dredged channels are reasonably permanent. The largest steamboats using the river now navigate it throughout the year, but the extremely slow progress on the improvement, which has now continued for thirty years under meager appropriations, has resulted in other means of transportation and the diversion to railroads of traffic naturally tributary to the river.

Under the project, it was contemplated to first construct locks and dams to check or slack the current, then procure a deep channel by dredging in the pools created. The locks and dams have been built at great expense after long and tedious delays for money, but the channels must be dredged to avail of their full capacity or to obtain the object sought. Every yard of material now removed improves the channel and immediately makes effective to that extent the preliminary locks and dams. The dredging is the effective work. The locks and dams give from 3 to 4 feet, which the dredging must increase to 7 feet.

Since the construction of the Lagrange Lock, in 1889, the traffic on the Illinois River has increased 200 per cent, and the attainment of 7 feet available depth will doubtless be followed by a materially greater increase in the use of the stream.

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Including one dredge temporarily borrowed from the Illinois and Mississippi Canal, there are now three dredges owned by the United States at work on the river, with the necessary scows for that number of dredges. The plant should be increased in capacity and the work be rapidly pressed to completion to avail of the expensive locks and dams, which deteriorate by lapse of time and disuse.

The following figures are taken from the annual report of the Merchants' Exchange, St. Louis, Mo., for the calendar year 1896:

Arrivals and departures of steamboats and barges at St. Louis, Mo., via Illinois River.

Month.	Arrivals.	Departures.	Receipts.	Shipments.
			Tons.	*Tons.*
February	3	1	680	.....
March	25	23	2,020	1,050
April	26	27	10,300	1,705
May	24	18	8,555	1,325
June	11	9	1,020	1,265
July	13	13	2,015	1,785
August	13	15	2,465	1,458
September	16	16	1,020	1,165
October	9	9	790	1,480
November	7	6	810	520
December	4	4	50	.....
Total	151	129	30,325	11,780

July 1, 1896, balance unexpended	$41,125.74
June 30, 1897, amount expended during fiscal year	23,843.15
July 1, 1897, balance unexpended	17,282.59
July 1, 1897, outstanding liabilities	3,101.58
July 1, 1897, balance available	14,181.01
Amount (estimated) required for completion of existing project	357,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	357,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix I I 5.)

6. Operating and care of Lagrange and Kampsville locks, Illinois River, and approaches thereto.—These locks and dams have been operated and maintained under the indefinite appropriation provided for in section 4 of the river and harbor act of July 5, 1884.

Lagrange Lock and Dam.—These works were operated and maintained in good order during the year. The drift was kept cleared from the dam; the pointing of lock walls completed; 1,117 cubic yards mud was dredged from the approach above the lock, and 19,814 cubic yards from Meredosia Bar below the lock; a small warehouse was constructed, and a new hull was built for the cabin of an old quarter boat pertaining to the work.

The hull of Dredge No. 2 begun during preceding fiscal year was completed.

Kampsville Lock and Dam.—A small amount of dredging was done at the approaches to the lock; 3,720 cubic yards of earth filling was put upon the grounds. Three of the barges pertaining to the operating and care plant were calked and repaired, and the house for the lock hands that was wrecked by the storm of July 31, 1896, was rebuilt by the lock hands.

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The lockages of boats through the Lagrange Lock increased from 504 in 1896 to 640 in 1897, and the tonnage from 129,297 in 1896 to 167,641 in 1897. The average tonnage of the boats passing increased from 236 tons in 1896 to 262 tons in 1897.

At Kampsville Lock the lockages decreased from 592 in 1896 to 426 in 1897, but the tonnage increased from 165,686 tons in 1896 to 174,624 in 1897, and the average tonnage of boats and barges increased from 279 tons in 1896 to 409 tons in 1897.

There was an increase of tonnage passing the two locks of about 15 per cent over the preceding year.

(See Appendix I I 6.)

7. Illinois and Mississippi Canal, Illinois.—The object of the improvement is to furnish a link in a navigable waterway from Lake Michigan to the Mississippi River at the mouth of Rock River, Illinois.

The canal has been located on the Rock Island route approved by the Secretary of War October 27, 1888, as directed in the act of Congress of August 11, 1888. It proceeds from the Illinois River at its great bend 1¾ miles above the town of Hennepin, Ill.; thence via Bureau Creek Valley and over the summit to Rock River at the mouth of Green River; thence by slack water in Rock River, and a canal around the lower rapids of the river at Milan, to the Mississippi River at the mouth of Rock River.

The canal is to be at least 80 feet wide at the water surface, 7 feet deep, and with locks 170 feet long and 35 feet width of lock chamber, capable of passing barges carrying 600 tons (maximum) freight.

A report upon the location, with detailed estimates of cost, of this canal was submitted June 21, 1890, and published (without maps) by Congress as House Ex. Doc. No. 429, Fifty-first Congress, first session, and is also printed in Annual Report of the Chief of Engineers for 1890, Part III, page 2586.

The river and harbor act of September 19, 1890, made the first appropriation for the construction of the canal and directed work to be begun by the construction of one of the locks and dams in Rock River.

In accord with this act work was begun in July, 1892, near the mouth of Rock River, on the construction of a canal around the lower rapids of the river, which barred navigation, and since that date has been prosecuted with an intermission due to lack of necessary funds. The survey work, in locating the canal on the ground, and proceedings for acquiring title to the right of way have been continuous since October, 1890, and the canal has been definitely located on the ground throughout its entire extent.

There has been expended on this work up to the close of the fiscal year ending June 30, 1897, $1,203,887.55, and during the fiscal year ending June 30, 1897, $32,912.37.

The result of this expenditure has been—

First. The acquisition of the right of way for 4½ miles around the lower rapids of Rock River and the completion of 4½ miles of canal there, involving the construction of 4½ miles of earthwork in constructing the canal trunk, 3 locks, 1 railroad, and 2 highway swing bridges, 7 sluiceways and gates, 1 arch culvert, 2 dams 1,392 feet long across the arms of Rock River, 3 lock keepers' houses, 1 small office building, and a thorough riprapping of the canal banks not estimated for in original estimates.

Second. In the location on the ground and preparation of descriptions, plats, and abstracts of titles of all lands needed for the eastern section

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of the canal; same for feeder line and for lands to be overflowed or damaged by the dam at Sterling; the surveying and locating the western section throughout, and the final location of the canal throughout.

Two routes each were surveyed for the feeder and for the western section, resulting in the Sterling route being accepted for the feeder and the Green River route for the western section of the canal.

Third. In the practical completion of the earthwork over the first 8 miles of the eastern section and in the construction of the masonry and superstructure of 1 highway bridge, masonry of 7 locks, 1 aqueduct, 5 arch and 4 pipe culverts.

Fourth. In the acquisition by purchase or condemnation of 16 miles of the right of way for the eastern section and in putting under contract the earthwork and culverts and foundations over the second 8 miles of this section.

During the fiscal year ending June 30, 1897, the following work has been done:

As sufficient funds have not been available, no work of construction of magnitude could be undertaken.

Western section.—Eighteen thousand four hundred and twenty-eight cubic yards material was dredged from the Mississippi entrance to the canal. Four wing dams were constructed near the mouth of Rock River to contract and direct the current to aid in scouring away the sand bar at the western terminus of the canal.

Under date of February 1, 1897, the Secretary of War approved the location from Mile 28 to Rock River along the Green River route surveyed in 1896, and the lands needed are now being delimited and described.

Feeder line.—All maps, plans, descriptions of lands needed, and abstracts of title for the acquisition of title to right-of way for the feeder, and all data relating to overflowed areas were completed during the year, and together with such agreements as could be made by the Secretary of War (except tracts near the junction of feeder with main line) were forwarded to Washington for the action of the Attorney-General in the matter of titles.

Eastern section.—Lands required for right of way from Mile 17 to Mile 24, inclusive, were condemned by the United States circuit court in March and May, 1896, and awards made, but no record of the proceedings has yet been furnished to enable payments to be made and the work of construction inaugurated.

Thirty-one thousand seven hundred and sixty-eight cubic yards earthwork was placed on the sixth mile of canal trunk, completing the first 8 miles. All necessary office work for putting the eastern section under contract and in the preparation of data for acquiring right of way from Mile 25 to Mile 28, inclusive, was completed. Maps, plans, and specifications for the work over miles 9 to 16, inclusive, were prepared, and earthwork, foundations for 11 locks and 2 aqueducts, and all pipe and arch culverts were put under contract, and work is just beginning at the close of the year. Parties were organized for completing by hired labor revetment of banks and minor earthwork on first 8 miles.

It is very necessary, if this canal is to be completed under the provisions of the act of June 3, 1896, which provided for its completion in four years, that more effective machinery than is now available shall be provided for acquiring title to right of way.

It is proposed to construct the canal as rapidly as the right of way may be acquired.

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July 1, 1896, balance unexpended		$64,811.28
Amount appropriated by sundry civil act approved June 4, 1897		875,000.00
		939,811.28
June 30, 1897, amount expended during fiscal year		32,912.37
July 1, 1897, balance unexpended		906,898.91
July 1, 1897, outstanding liabilities	$4,100.55	
July 1, 1897, amount covered by uncompleted contracts	241,026.75	
		245,127.30
July 1, 1897, balance available		661,771.61

Amount (estimated) required for completion of existing project	4,835,960.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	1,980,480.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix I I 7.)

8. Operating and care of Illinois and Mississippi Canal; canal around lower rapids of Rock River at Milan, Ill.—This canal is 4½ miles in length, surmounting a fall of 18 feet, and the works operated and cared for include 3 locks, 3 swing bridges, 7 sluiceways, 1 arch culvert, 3 lock houses, 1 office building, and 2 dams.

The canal was formally opened to navigation April 17, 1895.

On account of three fixed bridges across Rock River a few miles above the head of the canal its traffic is restricted to excursion craft and to barges and such small steam craft as may pass under the bridges.

Proceedings are in progress to compel the city of Moline to alter its bridge. The United States district court for the northern district of Illinois in a preliminary opinion sustains the United States authority, and the city of Moline has until October, 1897, to answer the information and complaint of the United States.

The canal and its accessory works have been operated and maintained in good order during the past year; all lock gates and sluice gates and the lock keepers' houses were painted, also the fences about lock houses and the signal apparatus at bridges.

Fenders were placed on the crib approaches to guard lock; movable roofs for main supports of sluice gates were constructed and painted; willow settings planted as an experiment to protect canal banks, and Lupin seeds planted on sandy banks for the same purpose.

During the season of navigation vessels of 56,621 tons passed through the canal, 1,531 lockages were made, 1,151 passengers passed through, and 9,583 tons of freight.

The freight was mainly coal. The amount of it is limited by the obstructive bridges, especially the Moline wagon bridge, but the coal by canal controls the price at Davenport and vicinity, and this result has been in effect ever since the opening of the canal. A reduction of price of from 3 to 4 cents per bushel, or approximately $1 per ton, on all soft coal used has resulted, which has already justified the construction of this part of the canal as an independent work.

The change in the Moline bridge will make this canal an important line of transportation for coal.

There was expended during the year ending June 30, 1897, $4,752.46, exclusive of outstanding liabilities amounting to $869.70.

(See Appendix I I 8.)

9. Removing sunken vessels or craft obstructing or endangering navigation.—The steam barge *China* was sunk November 10, 1896, in one of

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the draws of the bridge across North Branch, Chicago River, at Chicago avenue, totally obstructing navigation through that draw. The wreck was removed under the provisions of the act of June 14, 1880, by contract, at a total cost of $549.71.

(See Appendix I I 9.)

EXAMINATION AND SURVEY MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The preliminary examination and survey of the following localities, required by the act of June 3, 1896, were made by the local engineer, Maj. W. L. Marshall, Corps of Engineers, and reports thereon submitted through the division engineer, Col. Henry M. Robert, Corps of Engineers:

1. Preliminary examination of upper Illinois River and lower Des Plaines River, Illinois, with a view to extension of navigation from Illinois River to Lake Michigan at or near Chicago.—Major Marshall submitted report of examination January 27, 1897. He states that the locality embraces an important commercial route between the Great Lakes and the Mississippi River system, and its utility and worthiness have long been recognized by Congress. The division engineer is of the opinion that the upper Illinois and lower Des Plaines rivers are worthy of improvement, and his views are concurred in by the Chief of Engineers. It is estimated that the cost of the necessary survey and preparation of detailed plans of improvement will be $75,000. The report was transmitted to Congress and printed in House Doc. No. 333, Fifty-fourth Congress, second session. (See also Appendix I I 10.)

2. Survey of Wolf Lake and River, Illinois and Indiana, with reference to their navigation in connection with the waters of Lake Michigan.—Major Marshall submitted report of survey December 24, 1896. He presents a plan providing for constructing an entrance to the river and lake 20 feet in depth, extending from 21 feet in Lake Michigan between piers 300 feet apart; for deepening, widening, and straightening Wolf River; constructing five swing bridges across the channel with drawspans of 100 feet each; building bulkheads or docks in the immediate vicinity of these bridges; constructing a turning or winding basin in Wolf Lake, and for dredging a channel 20 feet deep and 300 feet wide 7,400 linear feet in Wolf Lake. The estimated cost of this work is $1,395,042. The local officer states that in his opinion the improvement of navigation of Wolf Lake and River, with reference to their navigation in connection with the waters of Lake Michigan, is not now a public necessity, and that the locality at this time is not worthy of improvement by the General Government. His opinion is concurred in by the division engineer. The report was transmitted to Congress and printed in House Doc. No. 157, Fifty-fourth Congress, second session. (See also Appendix I I 11.)

IMPROVEMENT OF MICHIGAN CITY HARBOR, INDIANA, AND OF RIVERS AND HARBORS ON THE EASTERN SHORE OF LAKE MICHIGAN.

The works in this district were in the charge of Lieut. Col. G. J. Lydecker, Corps of Engineers, to August 31, 1896, and of Capt. C. McD. Townsend, Corps of Engineers, since that date. Division Engineers Col. Henry M. Robert, Corps of Engineers, from August 31, 1896, to May 7, 1897, and Col. J. W. Barlow, Corps of Engineers, since May 7, 1897.

1. Michigan City Harbor, Indiana.—The improvement of this harbor dates from 1836, and has resulted in establishing a convenient "inner

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harbor" for local commerce and partly completing an "outer harbor" designed to facilitate entrance to the former and afford refuge in times of northerly gales to vessels engaged in general lake commerce.

The inner harbor has been made by (1) deepening the entrance to Trail Creek and protecting the channel by piers extending to deep water in Lake Michigan, to which operations were limited until 1870, and (2) prolonging the entrance channel up the creek by dredging between revetments that are built on established dock lines at the expense of the adjoining property, as required by city ordinance. This work, commenced in 1882 and still in progress, has thus far resulted in an interior waterway over 9,000 feet long between substantial revetments from 125 to 175 feet apart, with turning basins about 350 feet wide at suitable intervals. A further extension of 1,300 feet is required to complete the existing project.

The total amount expended from 1836 to June 30, 1896 was $418,263.11, the available channel depth then being 12 feet.

The work during the past fiscal year has been confined to minor repairs and the care and preservation of plant.

The principal requirements for maintaining this harbor are dredging and repairs to old piers at entrance. The section of the old east pier beyond the shore line has hardly any timber work left above water line, and for a length of about 114 feet its top is several feet below water. The filling of the old west pier for a distance of 500 feet is defective and requires minor repairs.

July 1, 1896, balance unexpended	$13,495.66
June 30, 1897, amount expended during fiscal year	1,330.35
July 1, 1897, balance unexpended	12,165.31
July 1, 1897, amount covered by uncompleted contracts	4,000.00
July 1, 1897, balance available	8,165.31
Amount that can be profitably expended in fiscal year ending June 30, 1899 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	7,500.00

The outer harbor.—This comprises an outer basin of some 40 acres, located to the east of the entrance to the inner harbor, and an exterior detached breakwater to the westward, designed to give increased safety to vessels entering during heavy weather. The combination when completed is intended to provide a safe harbor of refuge against northerly gales for general commerce. The structures inclosing the basin comprise a pile pier 1,225 feet long, a crib breakwater 30 feet wide and 1,411 feet long, and a breakwater pier 30 feet wide and 505 feet long; in all, 3,141 feet. These were completed from 1870 to 1885, and expenditures applied thereto since that time have been for repairs simply.

The exterior breakwater lies in the open lake westward of the other harbor works, and if completed as projected will have a total length of 2,000 feet, comprised in two equal arms, making an interior angle of 130° with each other. Seven hundred feet of the easterly arm had been completed to June 30, 1896. The total amount expended to that date was $752,749.99.

The harbor of refuge, as projected in 1882, was designed for vessels drawing 12 feet, the class of vessels then navigating this southeastern portion of Lake Michigan. The increase in dimensions of vessels navigating the lakes at the present time renders necessary a modification of the existing project. During the past season no work has been done except the occasional repairs of decking of the breakwater, awaiting Congressional action on the subject.

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Under date of January 12, 1897, a modified project for construction of the outer breakwater was presented by the local engineer. This project was considered by a Board of Engineers, who submitted report dated March 6, 1897, in which a new project for improvement of this harbor was presented, the cost of which is estimated at $282,150, contemplating the removal of the outer western breakwater, the extension of the eastern harbor pier a distance of 600 feet, and the construction of a detached breakwater 1,500 feet long to protect the harbor from westerly storms. These reports and accompanying map are submitted herewith in Appendix J J 1.

July 1, 1896, balance unexpended	$89,125.01
June 30, 1897, amount expended during fiscal year	1,210.47
July 1, 1897, balance unexpended	87,914.54
Amount (estimated) required for completion of existing project	159,613.56
Amount that can be profitably expended in fiscal year ending June 30, 1899	140,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix J J 1.)

2. St. Joseph Harbor, Michigan.—The outlet of St. Joseph River into Lake Michigan was originally by a shifting channel, with depths fluctuating between 3 and 7 feet. Its improvement by the Government has extended through a period of sixty years, and expenditures for that purpose amounted to $460,835.87 up to June 30, 1896. The total estimated cost of the improvement, when completed as proposed by the revised project of 1892, is $519,113.

The objects sought by the present project are an entrance channel 270 feet wide and 16 feet deep, the extension of the same depth along the river front of St. Joseph, and an interior navigation of 13 feet from St. Joseph to Benton Harbor, nearly 1 mile above. The interior navigation is maintained as required by frequent dredgings. The proposed entrance depth of 16 feet has not yet been obtained because of insufficient pier extension, and the actual depth there available varies from 12 to 14 feet.

The amount expended during the past fiscal year was applied to dredging 105,241 cubic yards, the work covering all shoal parts of the channel from the entrance up to Benton Harbor, and to a reconstruction of broken sections of the north pier. The result of the dredging was to keep the channel open to navigation, and of the pier work to make the structure more secure against the passage of seas and sand through it into the channel way.

In order that the projected improvements at this harbor may be accomplished and maintained, it is most important that the piers be promptly extended and that both sides of the Benton Harbor Canal be protected by substantial and sand-tight revetments. If an entrance depth of 16 feet is to be obtained and kept, it can only be done by carrying the covering piers out to the curve of 18-foot depths beyond the outer bar. To carry the north pier to this 18-foot curve requires an extension of 1,000 feet, and it will take double that for the corresponding extension of the south pier.

The present approved project of improvement provides for only 850 linear feet of pier in addition to what is already built. This extension is intended to apply to the north pier. Experience has demonstrated that the extension of the south pier is also necessary. The estimate for pier extension is therefore limited accordingly. The appropriation made by the river and harbor act of June 3, 1896, will be absorbed in

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putting the old piers in safe and serviceable condition and in doing the large amount of dredging that is required under existing conditions for keeping the harbor open to navigation and commerce.

July 1, 1896, balance unexpended		$32,276.33
June 30, 1897, amount expended during fiscal year		18,207.87
July 1, 1897, balance unexpended		14,068.46
July 1, 1897, outstanding liabilities	$804.66	
July 1, 1897, amount covered by uncompleted contracts	9,038.21	
		9,842.87
July 1, 1897, balance available		4,225.59
Amount (estimated) required for completion of existing project		100,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix J J 2.)

3. St. Joseph River, Michigan.—The approved plan of improvement includes the stretch of river from its mouth, at St. Joseph, to Berrien Springs, 25 miles above. It provides for the removal of sunken logs, snags, closing secondary channels by dams of brush and stone, and wing dams at other points, as found necessary, to concentrate the flow of water and maintain a low-water navigation of 3 feet depth over the obstructing bars and shoals. The original estimate of cost of improving this section of the river so as to give it a navigable depth of 3 feet was $11,300. The amount expended to June 30, 1896, was $4,849.57, and the channel had thereby been increased from its original depth of about 2 feet to a depth of 3 feet at most of the worst places.

During the past fiscal year no work has been done.

July 1, 1896, balance unexpended	$650.43
June 30, 1897, amount expended during fiscal year	12.45
July 1, 1897, balance unexpended	637.98
July 1, 1897, outstanding liabilities	46.50
July 1, 1897, balance available	591.48
Amount (estimated) required for completion of existing project	5,800.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	1,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix J J 3.)

4. South Haven Harbor, Michigan.—Before improvement by the General Government the citizens of South Haven had constructed piers and revetments at the mouth of Black River, and thereby obtained a channel into Lake Michigan 6 or 7 feet deep and 85 feet wide. The improvement thus started was taken up by the Government in 1867, under a plan of operations that provided for increasing the channel to a width of 120 feet between piers extending far enough into Lake Michigan to obtain and hold a navigable depth of 12 feet. The original project was subsequently modified to make the entrance width between piers 177 feet and extend the navigable channel upstream to the highway bridge, about half a mile above the piers. The total length of piers and revetments built up to 1888 aggregated 3,145 feet, and no extensions have been made to them since that time.

The estimated cost of all work done and to be done under the present approved project is $262,000. The total expenditure to June 30, 1896, was $221,642.94, resulting in the construction and maintenance of piers

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and revetments indicated in the foregoing paragraph, and in repeated dredgings to provide the requisite channel depth.

During the past fiscal year the amount expended has been applied to the renewal of the superstructure of the piers where necessary.

To gain the object of the project of improvement adopted for this harbor—i. e., to provide and keep a reliable navigable channel 12 feet deep—it is necessary that the piers be extended to a depth of 15 feet in Lake Michigan, which will require additions of 250 and 450 feet to the north and south piers, respectively. A contract has been awarded for the extension of the south pier 350 feet.

July 1, 1896, balance unexpended		$30,357.06
June 30, 1897, amount expended during fiscal year		9,185.53
July 1, 1897, balance unexpended		21,171.53
July 1, 1897, outstanding liabilities	$12.00	
July 1, 1897, amount covered by uncompleted contracts	15,541.78	
		15,553.78
July 1, 1897, balance available		5,617.75

Amount (estimated) required for completion of existing project	45,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	45,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix J J 4.)

5. Saugatuck Harbor, Michigan.—This harbor is at the mouth of Kalamazoo River, where the channel depth before improvement was generally not over 5 feet. Its condition was first improved by a private company, which built two slab piers for confining the river current, and thereby obtained a channel depth of 7 feet temporarily. Its further improvement was commenced by the General Government in 1869, and from that time to 1882 the piers were extended and interior channel revetments constructed until they had a total length of 1,907 feet on the north and 3,863 feet on the south side, all pile work. Since 1882 the small appropriations made have been expended in dredging. The protecting revetments have gradually gone to decay, and the navigable channels opened through the harbor from time to time fill up again very soon after the departure of the dredge.

The estimates made for carrying on the work amount to $175,699.46, and the total expenditure to June 30, 1896, to $153,224.80, with results as indicated in the foregoing paragraph.

The amount expended during the past fiscal year was applied to dredging 109,018 cubic yards, the result of which was to open the channel to navigation during the busy part of the year.

The port of shipment out of this harbor is the town af Saugatuck, 3 miles above the entrance from Lake Michigan, and the natural difficulties in the way of making and maintaining a reliable navigation by the present line of water travel are exceedingly great, except at a cost that may be regarded as inadmissible, considering the commerce involved. This has led to the suggestion of an alternative project of improvement, and the river and harbor act of June 3, 1896, provided as follows concerning it:

> Improving Kalamazoo River, Michigan, from Lake Michigan to Saugatuck, in accordance with the alternative project submitted January twenty-eighth, eighteen hundred and ninety-six, five thousand dollars.

The last appropriation of $10,000 for Saugatuck Harbor has therefore been applied simply to maintain navigation by the present outlet until provision is made for completing the new one.

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It is estimated that $10,000 will be required for continuing improvement and for repairs at this harbor during fiscal year ending June 30, 1899.

July 1, 1896, balance unexpended		$14,214.20
June 30, 1897, amount expended during fiscal year		5,535.31
July 1, 1897, balance unexpended		8,678.89
July 1, 1897, outstanding liabilities	$147.31	
July 1, 1897, amount covered by uncompleted contracts	8,000.00	
		8,147.31
July 1, 1897, balance available		531.58
Amount that can be profitably expended in fiscal year ending June 30, 1899, in continuing improvement and for repairs. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		10,000.00

(See Appendix J J 5.)

6. *Kalamazoo River, Michigan.*—The project for improvement of Kalamazoo River provides for dredging the river for a distance of 1¾ miles below Saugatuck and making a new cut through to Lake Michigan, at an estimated cost of $150,000, to obtain an entrance channel having a depth of 12 feet.

The sum of $5,000, appropriated by the river and harbor act of June 3, 1896, is the first appropriation made, and nothing has been done under this project, as the funds available are inadequate to begin operations.

July 1, 1896, balance unexpended	$5,000.00
July 1, 1897, balance unexpended	5,000.00
Amount (estimated) required for completion of existing project	145,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	145,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix J J 6.)

7. *Holland (Black Lake) Harbor, Michigan.*—The first steps toward establishing a harbor at this place were taken by the citizens of Holland, Mich., situated on Black Lake, about 5 miles from the present harbor, by opening a channel having a navigable depth of about 5 feet from the lake into Lake Michigan, and protecting it by piers and revetments made of brush and stone. Continuation of this improvement was taken in hand by the General Government in 1867, existing structures strengthened by pile and crib work, and extended, until in 1880 the north pier and revetment had attained a total length of 1,854 feet and the south pier 1,691 feet. They have remained without extension since that time. The estimated cost of the present approved project was $291,615.13, and the amount expended to June 30, 1896, was $293,423.06. The results thereby attained have been the construction and maintenance of piers and revetments aggregating 3,545 feet in length, covering a channel way from 175 to 220 feet wide, in which a depth of 8 to 9 feet prevails, deepened by occasional dredging to 12 or 13 feet. The dredged channels have but little permanence because the piers are not long enough, and the older portions of them were in such condition as to permit the passage of large quantities of sand through and under them, by which the channel way between them soon fills to a general depth of 8 or 9 feet only.

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Expenditures during the past fiscal year resulted in keeping the harbor open to navigation by dredging during the busy season.

The proposed depth of 12 feet can not be maintained until the old piers are strengthened and sheet piled to make them sand-tight, and extended to the 15-foot curve in Lake Michigan. Such extension will require an addition of 400 feet to each, but it is not yet authorized.

July 1, 1896, balance unexpended		$11,191.06
June 30, 1897, amount expended during fiscal year		6,110.70
July 1, 1897, balance unexpended		5,080.36
July 1, 1897, outstanding liabilities	$28.00	
July 1, 1897, amount covered by uncompleted contracts	2,636.38	
		2,664.38
July 1, 1897, balance available		2,415.98
Amount that can be profitably expended in fiscal year ending June 30, 1899 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		15,000.00

(See Appendix J J 7.)

8. Grand Haven Harbor, Michigan.—This harbor is at the mouth of the Grand River, which had a shifting channel, with a depth of 9 feet at its mouth, before improvement. The first step in the line of improvement was taken by the Detroit, Grand Haven and Milwaukee Railroad Company, by constructing a pier on the south side to provide for the interchange of traffic between the railroad and its translake line of steamers. Its systematic improvement was commenced by the Government in 1867, and has resulted in the establishment of a harbor that not only satisfies the needs of an extensive local commerce, but gives to general commerce its only harbor of refuge from westerly gales on this coast south of Grand Traverse Bay.

The estimated cost of the work done and remaining to be done to complete the harbor, as provided in the approved project, amounts to $804,366.15, and the total expenditures thereon to June 30, 1896, were $720,500.81.

The works of improvement thereby built and kept in repairs comprise a north pier and revetment aggregating 3,538 feet in length, projecting 1,412 feet beyond the shore line, and a south pier and revetment 5,774 feet long, projecting 1,681 feet beyond the adjacent shore line.

Expenditures during the last fiscal year were applied to repairs to the piers where injured by boats striking them, and to dredging.

The formation of the shoal in front of the entrance is the principal difficulty that has to be contended with in the improvement of this harbor; pier extension alone will not solve the problem. The principal element that contributes to its formation is the sand blown into the harbor from the adjoining uncovered sand dunes, and then carried by the body of water flowing out of Grand River through the contracted waterway between the piers until the current is checked on spreading into Lake Michigan and no longer able to uphold its load of sand. It then falls to the lake bed and goes toward the upbuilding of the shoal. The remedy is to cut off the supply of sand by a growth of vegetation on the dunes adjoining the harbor, and supplement this with a suitable combination of sand fences. With this done and the piers extended, as required by the present approved project, a channel depth of full 18 feet at entrance may be counted upon. Nothing less will satisfy the important requirement of making this a safe harbor of refuge.

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July 1, 1896, balance unexpended		$38,865.34
June 30, 1897, amount expended during fiscal year		6,764.96
July 1, 1897, balance unexpended		32,100.38
July 1, 1897, outstanding liabilities	$430.09	
July 1, 1897, amount covered by uncompleted contracts	9,000.00	
		9,430.09
July 1, 1897, balance available		22,670.29

Amount (estimated) required for completion of existing project	45,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix J J 8.)

9. Grand River, Michigan.—The improvements of Grand River have been confined to the portion between Grand Rapids and its mouth, a distance of about 40 miles. In its original condition depths not exceeding 2 feet were found on some of the bars at extreme low water. A project adopted in 1881 provided for a channel with a depth of 4 feet through the shoals below Grand Rapids. Fifty thousand dollars was expended on this project between 1881 and 1886.

In 1896 a project was adopted providing for dredging a channel with a navigable depth of 10 feet, and bottom width of 100 feet, from Grand Rapids to Lake Michigan. The estimated cost was $670,500. No expenditures had been made under this project prior to June 30, 1896.

During the past fiscal year the expenditures have been applied to assembling plant, surveys, and dredging 14,035 cubic yards of material, the work of dredging having been begun May 26, 1897.

July 1, 1896, balance unexpended	$50,000.00
June 30, 1897, amount expended during fiscal year	8,420.02
July 1, 1897, balance unexpended	41,579.98
July 1, 1897, outstanding liabilities	1,409.63
July 1, 1897, balance available	40,170.35

Amount (estimated) required for completion of existing project	620,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	250,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix J J 9.)

10. Muskegon Harbor, Michigan.—The first improvement at this place was made at local expense by constructing slab piers and revetments so as to afford entrance from Lake Michigan to Muskegon Lake for vessels drawing 7 feet. The work was taken in hand by the Government in 1867, old piers were remodeled and extended across the bar at entrance, channel dredged, and a through depth of 12 feet obtained. Thereafter the piers were prolonged as necessitated by the steady lakeward progress of the shore line and sand deposits in advance of it, and a fair 12-foot channel thereby maintained, but the clear way between the piers was only 180 feet, making entrance dangerous in stormy weather. After 1882 this difficulty was remedied by building extensions of the north pier on a line 300 feet from the south pier and connecting the old and new lines by an oblique wing of crib work 330 feet long. In 1892 the project of improvement was amplified and defined with a view to securing and maintaining a navigable depth of 15 feet. Its estimated cost was $260,000. Prior to the adoption of this modified project operations had been carried on under appropriations made from time to time in such sums as were called for to meet immediate neces-

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sities, but without defined estimates of ultimate cost. The expenditures for the work so done amounted to $262,914.18.

The total expenditure to June 30, 1896, was $414,420.75, when the north pier and revetment had a completed length of 2,582.4 feet and the south pier 1,482.5 feet. The available channel depth was 14 feet.

Expenditures during the last fiscal year were applied to reconstructing the superstructure of the north pier from station 0 to 3+23, reenforcing both the north and south piers at the shore line with a row of sheet piling, the construction of a pile projection from the oblique portion of the north pier to interrupt the run of seas along it and prevent their deflection across the harbor, and to dredging to maintain the navigable channel, the amount of material removed being 44,840 cubic yards.

July 1, 1896, balance unexpended		$49,579.25
June 30, 1897, amount expended during fiscal year		15,921.15
July 1, 1897, balance unexpended		33,658.10
July 1, 1897, outstanding liabilities	$244.56	
July 1, 1897, amount covered by uncompleted contracts	18,131.30	
		18,375.86
July 1, 1897, balance available		15,282.24

Amount (estimated) required for completion of existing project	125,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	110,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix J J 10.)

11. White Lake Harbor, Michigan.—The improvement at this point contemplates the creation and maintenance of a channel 200 feet wide and 12 feet deep between revetments and piers extending to deep water in Lake Michigan, thereby providing easy entrance to White Lake. Before improvement the two lakes were connected by a narrow and winding stream with a navigable capacity of only 5 feet. The estimated cost of the improvement was originally $170,530.80, subsequently increased by additional projects of 1873, 1884, and 1892 to $337,550.

The total expenditure to June 30, 1896, was $276,152.56, and the harbor works then comprised a north pier 1,515 feet long projecting into Lake Michigan 355 feet beyond its shore line and a south pier 1,854 feet long projecting 720 feet beyond the shore line. The available depth at entrance was 10½ feet. The proposed depth of 12 feet has been obtained from time to time by dredging, but the channel so made soon shoals again, and this will continue to be the condition of affairs until the piers have been carried to the curve of 15 feet depth in Lake Michigan, now distant about 550 and 250 feet from the ends of the north and south piers, respectively.

The amount expended during the last fiscal year was applied to dredging, 32,979 cubic yards of material having been removed.

July 1, 1896, balance unexpended	$13,397.44
June 30, 1897, amount expended during fiscal year	4,207.70
July 1, 1897, balance unexpended	9,189.74

Amount (estimated) required for completion of existing project	48,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	48,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix J J 11.)

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12. Pentwater Harbor, Michigan.—Originally an unnavigable connection existed between Lake Michigan and Pentwater Lake, which had been improved by local interests so as to afford a narrow 4-foot channel at the time the Government work was commenced in 1867. The project of improvement then adopted and followed without modification until the present time aimed to increase the channel depth to 12 feet and maintain it between revetments and piers extending into Lake Michigan. Its estimated cost was $327,713.40.

The total expenditure to June 30, 1896, was $235,922.24. The length of north pier and revetment was 2,223 feet and of south pier 2,112 feet.

Expenditures during the past fiscal year were applied to dredging 16,675 cubic yards of material.

The present piers reach to but little beyond the 10-foot curve in Lake Michigan, and for this reason a greater navigable depth can not be kept, except as dredging serves to give it temporarily. Twelve feet, as called for by the approved project, can be obtained and held with any permanence only when the piers shall have been extended to the 15-foot curve, now 300 to 400 feet distant. As conditions now are, no matter how deep a channel may be made by dredging, it rapidly shoals to a depth of 9 or 10 feet only. The limit of extension at present authorized is 200 feet for the south and nothing for the north pier. The old portions of both piers should be rebuilt above water.

July 1, 1896, balance unexpended		$12,897.76
June 30, 1897, amount expended during fiscal year		5,342.72
July 1, 1897, balance unexpended		7,555.04
July 1, 1897, outstanding liabilities	$15.90	
July 1, 1897, amount covered by uncompleted contracts	193.23	
		209.13
July 1, 1897, balance available		7,345.91
Amount (estimated) required for completion of existing project		78,893.40
Amount that can be profitably expended in fiscal year ending June 30, 1899		40,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix J J 12.)

13. Ludington Harbor, Michigan.—Before the Government undertook any work for improving this harbor local enterprise had made a narrow 7-foot channel from Lake Michigan to Pere Marquette Lake, and maintained it for several years. The Government work was commenced in 1867, with the purpose of enlarging the channel to a width of 200 feet and depth of 12 feet and protecting it by piers projecting into Lake Michigan. The estimated cost was $270,682. The improvement was duly made, and subsequently maintained by periodical dredging and pier extensions. In 1890 the scope of the design was enlarged, and 18 feet was fixed upon as the depth to be obtained, thereby necessitating extensions of 500 and 700 feet to the north and south piers, respectively. It was further designed that these extensions should be so made as to increase the width at entrance to 250 feet. These extensions have been so made, but the full depth of 18 feet has not yet been fully realized.

The total expenditure on the original and modified projects to June 30, 1896, was $360,205.36, resulting in a 14-foot channel between piers aggregating 3,833 feet in length.

The amount spent during the last fiscal year was applied mainly to dredging and repairs of piers. The amount dredged was 58,827 cubic yards, by which the depth of channel was temporarily increased to 18 feet.

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July 1, 1896, balance unexpended		$28,228.74
June 30, 1897, amount expended during fiscal year		8,614.54
July 1, 1897, balance unexpended		19,614.20
July 1, 1897, outstanding liabilities	$443.14	
July 1, 1897, amount covered by uncompleted contracts	8,995.19	
		9,438.33
July 1, 1897, balance available		10,175.87
Amount that can be profitably expended in fiscal year ending June 30, 1899 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		15,000.00

(See Appendix J J 13.)

14. Manistee Harbor, Michigan.—Before the Government undertook any work at this place local enterprise had opened an entrance to the river for vessels drawing 7 feet. Systematic work was commenced by the Government in 1867, under a project for pier construction and dredging, with a view of forming and maintaining a navigable channel 12 feet deep at the entrance to and between the piers. The project was extended in 1873 to include dredging in the river for a distance of about 1,350 feet inside the shore end of piers and to constructing revetments along the line of channel so dredged. In 1890 the scope of operations was again extended to include dredging a channel 15 feet deep throughout the length of the Manistee River, a distance of about 8,000 feet, from Lake Michigan to Manistee Lake, and to extending the north and south piers, respectively, to the 18 and 14 foot curves in Lake Michigan, with a view to maintaining that depth of channel at the entrance. The river channel was dredged through in 1891–92, and the proposed extension of the north pier was completed in 1893. The south pier has not yet been extended.

The cost of all the work done to June 30, 1896, was $347,825.84. The total length of piers was then 4,105 feet, and the available depth at entrance and between them 14 feet, that in the river above being but 12 feet.

The amount expended during the last fiscal year was applied to the reconstruction of the superstructure of 389 feet of the north pier and 516 feet of the south pier, and dredging both at the entrance, between piers, and in the river, the amount of material removed having been 28,018 cubic yards.

The 350-foot extension of the south pier, as contemplated by the present approved project, has become urgently necessary for preserving the prescribed depth at entrance.

July 1, 1896, balance unexpended		$27,174.16
June 30, 1897, amount expended during fiscal year		12,175.98
July 1, 1897, balance unexpended		14,998.18
July 1, 1897, amount covered by uncompleted contracts		1,500.00
July 1, 1897, balance available		13,498.18
Amount (estimated) required for completion of existing project		50,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		50,000.00

(See Appendix J J 14.)

15. Harbor of refuge at Portage Lake, Manistee County, Mich.—The great need of a harbor of refuge in this vicinity has long been recognized, and the peculiar adaptability of Portage Lake led to its selection

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for this purpose as far back as 1878. In 1879 Congress made the first appropriation for the work, but its amount, $10,000, was wholly inadequate for the object in view, and the subsequent appropriations have been insufficient to complete the work.

The expenditure to June 30, 1896, was $111,451.61.

The amount expended during the last fiscal year was applied to dredging 34,542 cubic yards in the channel, and to rebuilding a substantial new channel wall to replace the old one of the south pier, in this way restoring it to a good, serviceable condition.

The local interests concerned in this improvement are very small, so much so that no record of local commerce can be obtained, and it is freely admitted that no exhibit could be made that would justify any considerable expenditure by the Government on that account alone; but there can be no question as to the benefits that a safe and easily entered harbor of refuge at this point would supply to general commerce.

The money now available will be expended in restoring the south pier. With these results accomplished both piers should be promptly extended, if the harbor of refuge project is ever to be realized. They must go out to the 20-foot curve, if the prescribed depth of 18 feet is to be maintained, and nothing less than that will make the harbor of any considerable service as a refuge. This would require extensions of 700 and 900 feet to the north and south piers, respectively, which would cost about $125,000 if built under a single appropriation, but much more if the work has to be done in short sections. To dredge the channel between the piers to a depth of 18 feet would require the excavation of about 300,000 cubic yards of material, and would probably cost about $35,000.

July 1, 1896, balance unexpended		$39,048.39
June 30, 1897, amount expended during fiscal year		12,656.04
July 1, 1897, balance unexpended		26,392.35
July 1, 1897, outstanding liabilities	$159.03	
July 1, 1897, amount covered by uncompleted contracts	11,318.41	
		11,477.44
July 1, 1897, balance available		14,914.91
Amount (estimated) required for completion of existing project		160,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		160,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix J J 15.)

16. Frankfort Harbor, Michigan.—Before any work was done by the Government, Lake Aux Becs Scies (Frankfort) could be entered from Lake Michigan by a narrow and uncertain channel 3 or 4 feet deep. The project adopted on commencing improvements in 1867 was to dredge a new connecting channel 12 feet deep and 200 feet wide, and to protect its sides by pile revetments and its entrance by crib piers extending 672 feet into Lake Michigan on the north side and 832 feet on the south side. The estimated cost was $146,400. This project was afterwards modified from time to time to provide for repairs, dredging, and necessary pier extension, until, in the project as adopted in 1892, the original estimate had been increased to $325,659.85 as the total estimated cost of original construction, maintenance and repairs, and new work. The river and harbor act of June 3, 1896, provides for a navigable channel 18 feet deep.

Up to the close of the fiscal year ending June 30, 1896, the total expenditure was $291,224.43. The north pier had a length of 1,499

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linear feet, and the south pier 1,137 feet, while an uncertain channel 12 feet deep was maintained by repeated dredgings.

The amount expended during the past fiscal year was applied to building the superstructure to 600 feet of the cribs placed in position the preceding season, and to dredging, 37,593 cubic yards of material having been removed.

In addition to the pier extensions made by the Government, the Toledo and Ann Arbor Railway Company, under authority issued by the Secretary of War January 10, 1896, added 400 feet to the south pier extension at its own expense, for the better protection of its trans-lake car-ferry service, it having been specifically provided in such authorization that the work shall conform in all respects with plans and specifications relating to similar work that is being done by the Government.

An extension of 600 feet to the north pier, supplementing that being made by the railway company to the south pier, is essential to completing the improvement so as to provide a navigable depth of 18 feet, as required by the river and harbor act of June 3, 1896. The cost of such extension is estimated at $65,000.

July 1, 1896, balance unexpended	$51,713.92
June 30, 1897, amount expended during fiscal year	33,124.10
July 1, 1897, balance unexpended	18,589.82
July 1, 1897, outstanding liabilities	240.16
July 1, 1897, balance available	18,349.66
Amount (estimated) required for completion of existing project	65,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	65,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix J J 16.)

17. Charlevoix Harbor, Michigan.—The improvements at this place are designed to furnish access to Round and Pine lakes, situated in the northern part of the peninsula between Grand and Little Traverse bays. The original outlet from these lakes to Lake Michigan was a narrow stream through which boats drawing only 2 or 3 feet could pass. Local enterprise improved these conditions by dredging and pier construction so as to permit the passage of vessels drawing 6 feet. Work was then commenced by the Government with an appropriation of $10,000, made in the river and harbor act of August 14, 1876, the project providing for dredging a straight channel 100 feet wide to a navigable depth of 12 feet through Pine River to Round Lake and protecting its sides by pile revetments and its entrance by crib piers 150 feet apart, extending to 12 feet of water in Lake Michigan. This project was extended to provide a revetted channel 12 feet deep from Round to Pine Lake. With this modification the estimated total cost was $186,000. The amount expended to June 30, 1896, was $115,502.55, bringing the piers and revetments to the condition above indicated, and serving to keep the channel open to navigation by repeated dredgings.

The amount expended during the last fiscal year was applied to the partial reconstruction of the north pier.

The approved project calls for a channel 12 feet deep, and this requires that the piers shall extend to at least that depth in Lake Michigan. The north pier fulfills that condition, but the south pier must be prolonged 200 feet to do so.

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July 1, 1896, balance unexpended		$24,997.45
June 30, 1897, amount expended during fiscal year		3,191.15
July 1, 1897, balance unexpended		21,806.30
July 1, 1897, outstanding liabilities	$625.79	
July 1, 1897, amount covered by uncompleted contracts	5,068.52	
		5,694.31
July 1, 1897, balance available		16,111.99
Amount (estimated) required for completion of existing project		45,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix J J 17.)

18. Petoskey Harbor, Michigan.—Petoskey is so situated on the southeast shore of Little Traverse Bay that its water front is wholly exposed to winds coming from between west and northwest, and when high gales, with a sweep of more than 100 miles across Lake Michigan, blow from that quarter, it is impossible, or at least hazardous, to make a landing in the immediate vicinity. The question of improving this condition of affairs has been under consideration since 1884. Work was commenced in 1895, pursuant to the river and harbor act of August 18, 1894.

The estimated total cost of the project named in the act was $170,000, and it is described in the report to which reference is made as "the construction of an outer and detached work, so designed as to shelter the landing and possibly to furnish additional area within which vessels could take shelter on occasions." The total expenditure on account of the harbor to June 30, 1896, was $35,586.93, resulting in the construction of 600 feet of the breakwater pier.

The amount expended during the last fiscal year was applied to extending the west breakwater 200 feet.

July 1, 1896, balance unexpended	$17,413.07
June 30, 1897, amount expended during fiscal year	14,909.19
July 1, 1897, balance unexpended	2,503.88
Amount (estimated) required for completion of existing project	117,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	55,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix J J 18.)

19. Removing sunken vessels or craft obstructing or endangering navigation.—Wreck of steamer Reid.—The abandoned wreck of steamer *Reid* was removed from St. Joseph Harbor on May 23, 1897, by hired labor, after bids for its removal had been received, as required by law, and rejected as excessive. The cost of the removal, including advertising and printing, was $141.18.

(See Appendix J J 19.)

SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The surveys of the following localities, required by the act of June 3, 1896, were made by the local engineer, Capt. C. McD. Townsend, Corps of Engineers, and reports thereon submitted through the division engineer, Col. Henry M. Robert, Corps of Engineers:

1. Survey of South Haven Harbor, Michigan.—Captain Townsend sub-

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mitted report of survey January 21, 1897. He states that periodic dredging will always be necessary to maintain this harbor, but that its condition would be much improved by extending the piers to the 15-foot contour in Lake Michigan and repairing existing structures. The cost of the proposed work is estimated at $108,500. The report was transmitted to Congress and printed in House Doc. No. 279, Fifty-fourth Congress, second session. (See also Appendix J J 20.)

2. Survey of harbor at Holland (Black Lake), Mich., with a view of obtaining a 16-foot depth of water.—Captain Townsend submitted report of survey January 5, 1897. The plan of improvement presented for securing a 16-foot channel depth at the present stage of Lake Michigan provides for pier extension, repairs to existing structures, and dredging, and is estimated to cost $240,000. The report was transmitted to Congress and printed in House Doc. No. 272, Fifty-fourth Congress, second session. (See also Appendix J J 21.)

3. Survey of Ludington Harbor, Michigan.—Captain Townsend submitted report of survey January 2, 1897. The plan of improvement proposed contemplates obtaining a channel depth of 18 feet below the present water level of Lake Michigan, and provides for pier extensions, reconstruction and repairs to existing structures, and dredging. The cost is estimated at $210,000. The reconstruction and repairs to existing structures will be required for the maintenance of the existing project. The report was transmitted to Congress and printed in House Doc. No. 273, Fifty-fourth Congress, second session. (See also Appendix J J 22.)

4. Survey of Charlevoix Harbor, Michigan, with a view of obtaining 16-foot depth of water.—Captain Townsend submitted report of survey December 19, 1896. The plan of improvement presented provides for pier extension and dredging, together with repairs to existing structures, and the total cost of such work is estimated to be $160,000. The local officer considers the proposed improvement to be worthy and justified by the interests of commerce, but states that no extension of the existing project should be undertaken by the General Government until the local authorities remove the present bridge across Pine River, which would be a serious obstruction to navigation for vessels of greater draft than is contemplated by the existing project. The views of the local officer are concurred in by the Chief of Engineers. The report was transmitted to Congress and printed in House Doc. No. 144, Fifty-fourth Congress, second session. (See also Appendix J J 23.)

IMPROVEMENT OF RIVERS AND HARBORS ON THE EASTERN COAST OF MICHIGAN AND OF WATERS CONNECTING THE GREAT LAKES.

This district was in the charge of Lieut. Col. G. J. Lydecker, Corps of Engineers, having under his immediate orders Lieut. James B. Cavanaugh, Corps of Engineers, to September 25, 1896, and Lieut. James F. McIndoe, Corps of Engineers, since September 27, 1896.

1. Ship channel connecting waters of the Great Lakes between Chicago, Duluth, and Buffalo.—When this project was adopted the available depth in the connecting waters of the Great Lakes was about 16 feet, a condition that had been brought about, in part, by successive improvements of several localities where the original depth has been from 6 to 10 or 12 feet only. In the meantime, and pursuant to Congressional legislation, projects had been inaugurated for obtaining a navigable depth of 20 feet through the St. Marys Falls Canal, Hay Lake Channel of St. Marys River, and Limekiln crossing in Detroit River. To supplement this work and provide a channel of like navigable depth

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through other shoal places in the line of lake travel from the head of Lake Superior or Lake Michigan to Buffalo, at the foot of Lake Erie, the river and harbor act of July 13, 1892, appropriated as follows:

For ship channel twenty and twenty-one feet in depth and a minimum width of three hundred feet in the shallows of the connecting waters of the Great Lakes between Chicago, Duluth, and Buffalo, three hundred and seventy-five thousand dollars: *Provided*, That contracts may be entered into by the Secretary of War for such materials and work as may be necessary to carry out the plans proposed by General O. M. Poe, Corps of Engineers, United States Army, dated January twentieth, eighteen hundred and ninety-one, and printed as House Executive Document Numbered Two hundred and seven, second session, Fifty-first Congress, for such ship channel, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate two million nine hundred and sixty-five thousand dollars, exclusive of the amount herein appropriated.

The estimated total cost of work contemplated by the foregoing provision was $3,340,000.

Operations on this project were commenced under contracts entered into December 31, 1892 (actual work not beginning until the following spring), and, supplemented by subsequent contracts, have continued until the present time, except as temporary suspensions became necessary on account of lack of funds or the unfavorable weather conditions that prevail annually between the months of November and May. The aggregate amount of excavation accomplished under the several contracts to June 30, 1896, was 7,852,730 cubic yards.

The amount expended to June 30, 1896, was $1,694,394.38, and the result of it was to have entirely or nearly completed at that time channels through all of the shoals contemplated in the original estimate, as follows:

Sections 1 and 2.—Shoals at the head of St. Marys River.—Channels excavated to a width of 300 feet and depth of 21 feet. Contracts completed.

Section 3.—Ledge of limestone rock abreast of Sailors Encampment Island, St. Marys River.—General excavation of channel completed to a width of 300 feet and depth of 21 feet, but considerable work of clearing to bottom grade remaining to be done.

Section 4.—Shoal in Mud Lake, 1½ miles below Sailors Encampment Island.—Channel excavated to width of 300 feet and depth of 21 feet. Contract completed.

Section 5.—Shoals at foot of Lake Huron.—Channel nearly completed with a width of 2,400 feet and depth of 21 feet; east half of channel fully completed and opened to navigation, and the west half nearly completed.

Section 6.—Channel 20 feet deep from deep water in St. Clair River through St. Clair Flats Canal and to deep water in Lake St. Clair; greatest width 650 feet in the river above the canal, 800 feet in the lake below canal, and about 280 feet through the canal, where the waterway is between parallel dikes 300 feet apart. Contract completed.

Section 7.—Grossepoint Flats at foot of Lake St. Clair, and through shoal water north of these flats.—Channel completed for a length of about 20,000 feet, 800 feet wide and 20 feet deep; channel dredged for a further distance of 18,400 feet, but not cleaned up; a length of about 20,000 feet remained to be dredged, but the depth of cutting in this portion averages only about 1 foot.

Section 8.—Bar at mouth of Detroit River.—Channel excavated to width of 800 feet and depth of 21 feet, with many projections left above grade and considerable clearing up required to complete the work.

During the fiscal year ending June 30, 1897, operations resulted in

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completing all the unfinished work referred to above, except that in section 8, and that section will also be finished in a very short time if the contractor makes proper effort to do so. The removal of a bad shoal at the foot of Mud Lake, opposite Point Aux Frênes was also nearly completed. Expenditures during the year amounted to $518,117.97, and at its close there were outstanding liabilities, in the nature of amounts due contractors for completed work, etc.. aggregating about $177,606.88 more.

The sundry civil act approved June 4, 1897, appropriated $1,090,000 "for completing improvement of channel connecting the waters of the Great Lakes between Chicago, Duluth, and Buffalo, including necessary observations and investigations in connection with the preservation of such channel depth." * * * This makes the total of appropriation equal to original estimate of total cost, and it will suffice for doing all that was contemplated by that estimate; but the estimate was predicated on such general information as was available at the time, no specific surveys having then been made, and the development of shoals or dangers then unknown, or not considered in the estimate, was indicated as being highly probable. It is now certain that additional funds will be required for the proper completion of this important commercial highway, but the submission of an estimate for that purpose is deferred until called for by Congress.

Traffic through the St. Marys River section of this channel during the navigable season of 1896 comprised 16,239,061 tons of freight, valued at $195,146,842, and through the Detroit River about 27,900,520 tons, valued at $300,000,000.

July 1, 1896, balance unexpended		$558,383.68
Amount appropriated by sundry civil act approved June 4, 1897		1,090,000.00
		1,648,383.68
June 30, 1897, amount expended during fiscal year		518,117.97
July 1, 1897, balance unexpended		1,130,265.71
July 1, 1897, outstanding liabilities	$177,606.88	
July 1, 1897, amount covered by uncompleted contracts	2,610.79	
		180,217.67
July 1, 1897, balance available		950,048.04

(See Appendix K K 1.)

2. St. Marys River at the Falls, Michigan.—When the present project of improvement was adopted the maximum draft which vessels could carry through the canal and locks at Sault Ste. Marie, Mich., was 16 feet; the old State Lock of 1855 was 700 feet long between gates and 70 feet wide, with 11½ feet of water over miter sills; the United States Lock of 1881, now known as the Weitzel Lock, was 515 feet long between gates and 80 feet wide, with 17 feet depth over miter sills. Immediately after the Weitzel Lock was opened to traffic an astonishing increase in commerce took place; a like increase in the size of the vessels engaged in it followed, and a corresponding increase of navigable depth and locking capacity became imperative. The project of October 18, 1886, was promptly adopted to meet these requirements, its leading features being to construct at the site of the old State Lock a new lock 800 feet long between gates, 100 feet wide, with a depth of 21 feet over miter sills, and to provide it with the best possible operating machinery for the rapid passage of commerce, the canal and its approaches to be enlarged and deepened correspondingly. The estimated cost of the projected work was $4,738,865. Details of project

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and estimate are published in the Annual Report of the Chief of Engineers for 1887, pages 2220 to 2223.

Work was commenced in 1887 and is still in progress; until 1890 it was prosecuted under successive appropriations, but the river and harbor act of September 19, 1890, provided for its completion under the continuing-contract system, and the appropriation made by the sundry civil act of March 2, 1895, brought the aggregate of appropriations up to the amount called for by the original estimate.

The amount expended to June 30, 1896, was $3,319,161.16, and the general condition of the improvement was then as follows: The lock was practically completed and most of its operating machinery set up; the walls and floors of the power house were completed and material for its roof delivered; the general work of deepening the canal was finished, but operations on the immediate approaches were still in progress.

Operations during the past fiscal year have resulted in completing all work under contract, except that relating to the power house. The new 800-foot lock, now known as the Poe Lock, was opened to traffic at 10 a. m., August 3, 1896, and from that time to the end of the fiscal year 5,839 vessels passed through it, the aggregate registered tonnage being 6,812,586, navigation of the St. Marys River having been suspended from December 9, 1896, to April 20, 1897.

The lock was put in service at the earliest date possible, but a great deal of work yet remains to be done for the satisfactory completion of many details of the operating machinery and power house, grading and regulating grounds, removing the old movable dam and replacing it by a new structure suitably adapted to the enlarged canal and increased traffic, etc. No additional estimate is submitted, as the balance of previous appropriations will suffice for all work now contemplated.

The commerce passing the Falls of the St. Marys River during the navigable season of 1896, a period of 232 days, comprised 16,239,061 tons of freight, valued at $195,146,842. The number of passengers reported on vessels during the same period was 37,066.

July 1, 1896, balance unexpended		$1,444,742.60
October 28, 1896, repayment of disallowance of part of voucher 24, September, 1896		.80
		1,444,743.40
June 30, 1897, amount expended during fiscal year (including 67 cents paid by Treasury Department, account Western Union Telegraph Company)		242,629.96
July 1, 1897, balance unexpended		1,201,913.44
July 1, 1897, outstanding liabilities	$59,846.39	
July 1, 1897, amount covered by uncompleted contracts	16,893.35	
		76,739.74
July 1, 1897, balance available		1,125,173.70

(See Appendix K K 2.)

3. Operating and care of St. Marys Falls Canal, Michigan.—This canal was open to navigation two hundred and thirty-two days during the fiscal year, the closed winter season having comprised the period between December 8, 1896, and April 21, 1897. The old lock of 1881, known as the Weitzel Lock, was in operation throughout the navigable season; the new 800-foot lock, known as the Poe Lock, was first opened to traffic August 3, 1896, and continued in service thereafter, both locks being operated in such way as to best serve the interests of commerce. A total of 12,291 vessels, aggregating 12,277,458 registered

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tonnage and carrying 11,827,359 tons of freight and 20,900 passengers, passed through the locks in 5,780 lockages.

The staple articles transported were 2,064,270 tons coal, 7,733,707 barrels flour, 41,799,722 bushels wheat, 26,964,541 bushels grain other than wheat, 107,036 tons manufactured and pig iron, 215,254 barrels salt, 110,746 tons copper, 5,414,188 tons iron ore, 664,123 feet B. M. lumber, 240 tons silver ore, 14,459 tons building stone, and 441,122 tons unclassified freight.

The Canadian Canal was opened to navigation during the fiscal year two hundred and thirty-four days. A total of 4,550 vessels, aggregating 3,655,885 registered tonnage and carrying 3,990,218 tons of freight and 13,110 passengers, were passed in 2,717 lockages.

The amount expended during the fiscal year ending June 30, 1897, was $78,104.05.

(See Appendix K K 3.)

4. Hay Lake Channel, St. Marys River, Michigan.—Before improvement navigation via Hay Lake was impossible for commercial purposes on account of rapids and shoals at the head and foot of the lake. The original project of improvement, October 27, 1882, contemplated a channel 300 feet wide and 17 feet deep through the obstructed sections, so as to pass from the then navigable channel of the St. Marys River into Hay Lake at the head of Sugar Island, and then, by way of the Middle Neebish, to rejoin the navigable channel of the river at the foot of Sugar Island, thus saving a distance of 11 miles and obtaining a safe route for travel by night, which was not practicable by the old channel. The estimated cost of this project was $2,127,292. The project was modified in 1886 to increase the navigable depth to 20 feet, and in 1896 to make the channel wider at angles and other critical points. The estimated cost of the modified project of 1886 was $2,659,115.

The work of improvement was commenced in 1883, and the route opened to commerce June 7, 1894, though the full width of channel had not then been completed at all points. Operations since then have been directed toward obtaining the width requisite for safe navigation. The river and harbor act of September 19, 1890, put this important work under the continuing-contract system, thereby very materially reducing its cost and expediting its completion.

The amount expended to the close of the fiscal year ending June 30, 1896, was $1,877,858.96.

The improved channel was excavated to a depth of 20 feet below the assumed mean water surface where the bottom was in soft material, and 21 feet in rock or other hard bottom, except for a length of about 2,500 feet of rock cutting in the Middle Neebish, where a depth of only 20 feet was made. The first work done on the improvement covered this section of the Neebish, and the depth of excavation there was referred to a higher water surface than that subsequently assumed for the other sections. The result is that the safe navigable depth in this section is approximately 2 feet less than in other parts of the improvement.

The result of this improvement is that practically all commerce of the St. Marys River now passes by this route, as only rafts and a few small vessels engaged in local traffic continue to follow the old channel; the distance from the mouth of the St. Marys River to the canal at Sault Ste. Marie is shortened 11 miles, or 19 per cent, and night navigation of the entire route is now safe, whereas it was impracticable before. The amount of freight passing through this improved channel during the navigation season of 1895 (231 days) was 15,062,580 tons,

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valued at $159,575,129; for the season of 1896 (232 days) it was 16,239,061 tons, valued at $195,146,842.

During the last fiscal year several isolated shoals on or near the line of travel were removed, and the width of channel increased at angular points or other places where special danger to navigation had been found to exist. The work done has resulted in making navigation easier and very much safer.

In order to complete the improvement so that navigation may be reasonably safe throughout this route, it is highly important that the Middle Neebish section be made wider and deeper; the depth there, as before indicated, is less than in any other portion, being about 1 foot less than in the soft-bottom channels and 2 feet less than in those with hard or rock bottoms; the cut is through solid rock and has nearly vertical sides; the current is stronger than at any other place. Vessels passing through this reach generally hold closely to the mid-channel ranges, thereby risking collision between those passing in opposite directions; when they leave these ranges there is the risk of misjudging distances and striking on the sharp edge of the rocky cut. These conditions imply grave danger of a vessel being sunk at any time, especially at night or when it is foggy, and if such mishap take place navigation will in all probability be completely blocked until the wreck can be removed. The estimated cost of the completed improvement was $2,659,115, and the amount heretofore appropriated is $2,165,000; the appropriation of the remaining $494,115 is necessary to complete the Neebish section as indicated above.

July 1, 1896, balance unexpended		$287,283.51
June 30, 1897, amount expended during fiscal year		63,159.41
July 1, 1897, balance unexpended		224,124.10
July 1, 1897, outstanding liabilities	$17,470.35	
July 1, 1897, amount covered by uncompleted contracts	9,886.00	
		27,356.35
July 1, 1897, balance available		196,767.75

Amount (estimated) required for completion of existing project	494,115.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	494,115.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix K K 4.)

5. *Cheboygan Harbor, Michigan.*—The present harbor is the result of improvements made at the mouth of Cheboygan Harbor since 1871, when the available depth of water was only 6 feet. The original project called for a channel 200 feet wide and 14 feet deep, and the estimated cost of the whole work was $395,335. The project was modified in 1880 to increase the depth to 15 feet. These projects were duly carried out, the last named being completed in 1889, when the 15-foot channel had been dredged to 200 feet wide from deep water in the Straits of Mackinac to the State Road Bridge, a distance of about 1¼ miles. A 40-foot square crib was built in 1881 to mark the entrance to the channel, and a lighthouse was subsequently placed on it by the United States Light-House Establishment.

The channel was redredged through most of its length, 110 feet wide, in 1895.

The total expenditure to June 30, 1896, was $147,929.44, with results as above indicated. The available channel depth at that date was 14½ feet.

No work was done during the past fiscal year, the expenditure during

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that period being $70.05, which was applied to paying liabilities outstanding June 30, 1896, and to general contingencies of office, engineering, and inspections during the year. An examination of the channel made in June, 1897, shows about the same depth as in the preceding June, the higher stage of water in the lake serving to make up for such filling as took place during the year.

Under the provisions of the river and harbor act of August 18, 1894, an estimate for increasing the navigable depth to 18 feet was submitted, and the act of June 3, 1896, appropriated $12,000 for this purpose. The total estimated cost of the project was $33,000, and it will not be expedient to enter upon it until the means available will suffice for dredging the entire length of channel to the prescribed depth for a width of at least 125 feet. An additional appropriation of $10,000 would accomplish this object.

The following statement indicates the commerce of this harbor during the past four calendar years, as shown by data compiled from the most reliable information available:

Year.	Number of vessels.	Freight tonnage.	Year.	Number of vessels.	Freight tonnage.
1893	940	441,087	1895	1,249	326,930
1894	1,033	303,900	1896	1,040	525,373

July 1, 1896, balance unexpended	$12,070.56
June 30, 1897, amount expended during fiscal year (including $3.05 paid by Treasury Department, account of F. and P. M. R. R. Co.)	70.05
July 1, 1897, balance unexpended	12,000.51
Amount (estimated) required for completion of existing project	21,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix K K 5.)

6. Alpena Harbor (Thunder Bay River), Michigan.—The city of Alpena occupies both banks of Thunder Bay River at its mouth, and this reach of river, about a mile long, together with the dredged channel through the bar in advance of it, constitutes Alpena Harbor, and it has been the subject of improvements heretofore carried on by the Government under appropriations for improving Thunder Bay Harbor and Thunder Bay River.

The original depth at entrance to the river was only 7 feet, but local enterprise increased it to 12 feet. The work of improvement by the Government has provided a wider channel and increased the depth to 13, 14, and 16 feet, under successive projects, whose costs were estimated as $4,764, $15,000, and $36,087, respectively, the total of the three separate estimates being $55,851. The proposed work was completed in 1893, and nothing has been done since then.

The total amount expended to June 30, 1896, was $41,508.23.

The dredged channel has a total length of about 7,000 feet; its width is 200 feet at entrance of cut through the bar, 150 feet at a point of entrance between piers, and from that point, conforming to the distance between dock lines established, the width of 100 feet is held for a distance of 2,600 feet, beyond which it is 75 feet for a distance of 1,500 feet, and thence 50 feet to the head of navigation. The depth June 30, 1896, was 13½ feet.

No work was done during the last fiscal year, expenditures during

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that period being $189.05, which was applied to general contingencies of office, supervision, and inspection.

Soundings were taken in the channel June, 1897, extending from the entrance up to the first bridge over the river, the section above that point being so blockaded by rafts and logs in boom as to render its examination impossible. These soundings show that the 16-foot channel has shoaled to a navigable capacity of 12½ feet at the stage of water now prevailing. Funds on hand will permit the dredging to be done that is needed to restore the depth required for the present commerce of the harbor, and the work will probably be done during the ensuing fiscal year. To maintain the required depth occasional dredging will be necessary, but no estimate is now submitted for that purpose in the absence of an approved project for such work.

The following statement indicates the commerce of this harbor during the past four calendar years, as shown by data compiled from the most reliable information available:

Year.	Number of vessels.	Freight tonnage.	Year.	Number of vessels.	Freight tonnage.
1893	940	360,588	1895	1,249	305,160
1894	1,033	465,991	1896	1,040	349,754

July 1, 1896, balance unexpended	$9,991.77
June 30, 1897, amount expended during fiscal year	189.05
July 1, 1897, balance unexpended	9,802.72

(See Appendix K K 6.)

7. *Saginaw River, Michigan.*—Before improvement the navigable capacity of this stream was limited by the bar at its mouth, where a channel depth of 8 feet only was available, and by many shoal stretches in the river between there and the city of Saginaw, over which still less depth was to be found. Its improvement was commenced in 1867 by dredging a straight cut through the bar at the mouth to a depth of 13 feet, the work being completed in the following years. In subsequent years the scope of operations was gradually extended to various shoals higher up, but subject to no general project until 1882, when a comprehensive and connected scheme of improvement covering the entire river was proposed and adopted. It called for a navigable channel 14 feet deep and 200 feet wide from Saginaw Bay to the upper limits of Bay City, about 8 miles above the point of beginning, and thence to the head of navigation, some 16 miles farther up, a channel of the same width, but only 12 feet deep. The estimated cost of this project was $446,000, which, added to the estimated cost of the several preceding projects ($294,378), gives $740,378 as the estimate of cost for the whole improvement. These estimates concerned the question of original cost only, and took no note of maintenance, which, in a stream of this character, is a matter of great and constant expense, and in the absence of appropriations specifically applicable thereto must be an annual tax of no small magnitude on the successive appropriations for construction. The sum total of appropriations that will have to be made before the work can be completed must therefore largely exceed the original estimates for construction only.

The total expenditure to June 30, 1896, was $697,145.81, and the result obtained was a through channel, with depths as proposed, from the bay to near the head of navigation. The channel had its full width of 200 feet in nearly all parts up to and including the Bay City front, but

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above there the width was only from a quarter to a half of what is required; frequent redredging has been required to maintain the originally dredged channel.

The amount expended during the last fiscal year was $11,971.46. This expenditure was applied to completing work of redredging bar at mouth, which was in progress until July 15, 1896, and to certain surveys and estimates directed by the river and harbor act of June 3, 1896, as follows:

Improving Saginaw River, Michigan: Continuing improvement, $40,000, of which $16,000 shall be expended on the river above Bay City. The Secretary of War is hereby directed to cause surveys to be made and estimates of the cost of improvement of the Saginaw River from its head to a point in Saginaw Bay, with a view of securing a channel two hundred feet wide and an increase in depth to fourteen feet from the head of the river to Third Street Bridge, so called, in Bay City, thence of the same width to Saginaw Bay with a view to securing an increase of the depth of the channel to sixteen feet; also to submit plans and estimates for improving the west channel of the Saginaw River between the Middle Ground and West Bay City, with a view to securing a depth of said channel to fourteen feet; also to improve the Shiawassee River from the Saginaw River to the Bad River; Bad River to the village of Saint Charles, and the Flint River from the Shiawassee as far as practicable, to such an extent as will afford a reliable navigation for light-draft boats between Saginaw River and the village of Saint Charles, and on the Flint River as far as practicable.

The required surveys were made in January and February, 1897, and maps of surveys with estimates of cost have since then been prepared; the results will be presented in a special report.

It is believed that the improvement of the river as called for by the existing project can be accomplished only by continuous work, the cost of which would be at least $300,000; but the present requirements of commerce may be met by maintaining existing conditions, and an appropriation of $20,000 would probably suffice for such maintenance to June 30, 1899.

The following statement indicates the commerce of this river during the past four calendar years, as shown by data compiled from the most reliable information available:

Year.	Number of vessels.	Freight tonnage.	Year.	Number of vessels.	Freight tonnage.
1893	1,290	1,820,461	1895	226	738,897
1894	226	1,108,307	1896	189	711,602

July 1, 1896, balance unexpended	$50,604.19
June 30, 1897, amount expended during fiscal year	11,971.46
July 1, 1897, balance unexpended	38,632.73
July 1, 1897, outstanding liabilities	10.00
July 1, 1897, balance available	38,622.73
Amount that can be profitably expended in fiscal year ending June 30, 1899, for maintenance	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix K K 7.)

8. Sebewaing River, Michigan.—This stream discharges into the eastern part of Saginaw Bay.

In 1875 the river channel was straightened and deepened to 6 feet and a narrow channel 6 feet deep dredged from the mouth to the 6-foot contour in the bay. In 1880–81 the channels previously dredged were deepened by about 1 foot.

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The total expenditure in these operations was $15,000.

The present project for improvement, adopted by the river and harbor act of June 3, 1896, provides for dredging the entrance channel for a length of about 15,000 feet to a width of 100 feet and depth of 8 feet below the datum plane of the survey of 1895. The estimated cost of this work is, in round numbers, $37,000.

The appropriation made by the act of June 3, 1896, was only $5,000, but no work has yet been done, as it is believed that no useful result can be obtained by an expenditure of this small sum. If the project is to be carried out, it will need at least $15,000 with which to commence it and make any reasonable progress. With this it might be possible to make a narrow channel through the extensive shoal that obstructs approach to the mouth of the river. This channel will be nearly 3 miles long.

The commerce of Sebewaing during the past calendar year, as shown by data compiled from the best information available, amounted to a freight tonnage of 166,974, of which 30 per cent was carried by water, and it is represented that 30 per cent more will be added to the water traffic when the harbor facilities are improved.

July 1, 1896, balance unexpended	$5,000.00
July 1, 1897, balance unexpended	5,000.00
Amount (estimated) required for completion of existing project	32,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix K K 8.)

9. Harbor of refuge at Sand Beach, Lake Huron, Michigan.—The site for this harbor, selected in 1872 after careful consideration, is on the west shore of Lake Huron, 60 miles north of its outlet into the St. Clair River, and the artificial harbor built there since then is the only safe refuge on that coast from the foot of the lake to Tawas Bay, 115 miles above. The work of construction was commenced in 1873, under a project providing for three sections of breakwater, made of stone-filled crib work, so located as to shelter a water area of some 650 acres and for deepening this area by dredging where necessary. The estimated cost was $1,442,500. The sheltering breakwaters, with a total length of 8,132 feet, were completed in 1885 at a cost of about $975,000, and since that time expenditures have been applied to keeping them in repair, dredging, and supervising the berthing of vessels entering the harbor for refuge. The total expenditure to June 30, 1896, was $1,191,202.02. The amount expended during the last fiscal year was $5,102.84, and it was applied to supervising the use of the harbor and to minor repairs of its breakwaters.

The superstructure of breakwaters contains a large amount of timber that is in an advanced stage of decay, and it will probably require very considerable repairs to keep it serviceable; these repairs must be largely superficial, for they can not be applied to the unseen interior without great expense.

As respects the benefits to the general commerce on the Great Lakes, this harbor is second in importance to no other, but its local commercial interests are small. The number of vessels that took refuge at the harbor during the past fiscal year was 1,143, with a total tonnage of 421,346.73. The grand total of vessels entering for shelter during the calendar years 1877 to 1896, inclusive, is 23,802, the tonnage of which aggregated 7,857,282. The size of vessels sheltered in 1877 averaged 289 tons, and in 1896 this average had increased to 351 tons.

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The timber superstructure of the main breakwater, which is nearly a mile long, is in such an advanced state of decay that it is likely to be carried away by any heavy storm in the near future, and when this occurs the utility of the harbor will be destroyed to a corresponding extent. It is not safe to longer postpone provision for rebuilding the superstructure of this breakwater, and when rebuilt it should be of masonry. An additional appropriation of $250,000 is essential for this purpose, and it should be available for expenditure during the year ending June 30, 1899.

July 1, 1896, balance unexpended	$114,797.98
June 30, 1897, amount expended during fiscal year	5,102.84
July 1, 1897, balance unexpended	109,695.14
July 1, 1897, outstanding liabilities	382.00
July 1, 1897, balance available	109,313.14
Amount that can be profitably expended in fiscal year ending June 30, 1899 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	250,000.00

(See Appendix K K 9.)

10. St. Clair Flats Canal, Michigan.—The original condition of the channel before any improvement was commenced afforded only about 6 feet of water over the bar at the mouth of the South Pass.

The project for the improvement of the canal, as modified from time to time, provided for a double row of sheet piling to a depth of 26 feet along the channel face of each dike, dredging the area between the dikes to a depth of 20 feet, continuing the channel above and below the canal to the same depth in river and lake, and rebuilding the decayed portions of the timber superstructure. It was considered sufficient to obtain a depth of 18 feet and to postpone obtaining a depth of 20 feet until the general project for a continuous depth of 20 feet along the entire water route had reached a more advanced stage. The estimated cost, assuming a depth of 18 feet, was $365,000.

The total expenditure to June 30, 1896, was $760,223.46. No work was done during the last fiscal year. The timber work of old dikes is wholly rotten above water, and the ice protecting pile work at their ends must be renewed; the available balance of appropriations for the canal will suffice for this purpose, and therefore no additional estimate is submitted.

July 1, 1896, balance unexpended	$4,586.54
July 1, 1897, balance unexpended	4,586.54
July 1, 1897, outstanding liabilities	138.00
July 1, 1897, balance available	4,448.54

(See Appendix K K 10.)

11. Operating and care of St. Clair Flats Canal, Michigan.—Conforming with the plan that has been followed since the canal was opened to navigation in 1871, a custodian was present on the work during the season of navigation to watch the passage of vessels, enforce regulations respecting navigation through the canal and its approaches, and supervise such work as was requisite for ordinary care and repair of the canal dikes. Expenditures on this account during the fiscal year were $2,162.81.

Commerce on the lakes has become so great that a more efficient control of its passage through the canal has become necessary, and measures for accomplishing this object are now under consideration.

(See Appendix K K 11.)

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12. Mouth of Black River, Michigan.—An extensive shoal and a bar formerly existed in the St. Clair River, adjoining the mouth of the Black. The bar lay close to the American side and obstructed approach to the Port Huron docks, while the shoal, forming a "middle ground" nearly 50 acres in extent, crowded the main channel in a sharp curve close to the Canadian shore, thereby exposing the vast through commerce of the lakes to the dangers attendant upon passing a narrow and crooked channel with a current of high velocity. In 1871 a project was adopted for dredging the bar and middle ground to a uniform depth of 15 feet by excavating 257,200 cubic yards, at an estimated cost of $120,660. The work was commenced in 1872 and completed in 1878. A slight shoaling took place in the years following, and the whole area was redredged between 1889 and 1892, the depth of excavation this time being 16 feet, except over a strip bordering the main channel, where it was increased to 18 feet. The total expenditure to June 30, 1896, was $86,885.94.

No work was done from 1892 until June, 1897, when operations were commenced under a contract for redredging the shoal area to restore the navigable depth of 16 feet; only 729 cubic yards was excavated to the close of the fiscal year. The amount expended during the year was $42.79, being for office and engineering contingencies.

Funds available will probably suffice for the work now contemplated, but experience shows that the shoal will re-form; when this occurs further dredging will be required, but no project for maintaining the improvement has yet been authorized. The whole commerce between the upper and lower lakes passes through the channel adjoining this shoal, and it is clear that the latter should not be allowed to re-form to such an extent as to embarrass this vast commerce. It would therefore be a wise precaution to appropriate a small sum to provide for such emergency.

July 1, 1896, balance unexpended		$7,614.06
June 30, 1897, amount expended during fiscal year		42.79
July 1, 1897, balance unexpended		7,571.27
July 1, 1897, outstanding liabilities	$94.86	
July 1, 1897, amount covered by uncompleted contracts	5,927.10	
		6,021.96
July 1, 1897, balance available		1,549.31
Amount that can be profitably expended in fiscal year ending June 30, 1899. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		10,000.00

(See Appendix K K 12.)

13. Black River at Port Huron, Mich.—This stream passes through the city of Port Huron, Mich., and empties into the St. Clair River. Before improvement it had a general channel depth of not less than 10 feet, reduced to 8½ feet at several shoals. The river and harbor act of September 19, 1890, appropriated $25,000 for dredging the channel to a depth of 16 feet. Work was commenced in the year following, and continued until August, 1892, when 184,989 cubic yards had been dredged, resulting in a channel 16 feet deep, 150 feet wide from the mouth to the Flint and Pere Marquette Railway Bridge, 600 feet above, thence 100 feet wide to Haynes's lumber dock, 4,700 feet farther up, and thence 50 feet wide for the remaining distance of 3,000 feet to the Grand Trunk Railway Bridge. The next river and harbor act appropriated $10,000 for continuing the work, and directed that it be extended to Washington avenue, 1,400 feet above the Grand Trunk Bridge. This

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served for excavating 46,630 cubic yards during the summer of 1893, thereby widening the 50-foot section of channel previously dredged below the bridge to a width of 75 feet, and making a channel 50 feet wide up to Washington avenue. The total length of channel originally dredged to a depth of 16 feet is 9,700 feet.

No estimate for the completed improvement was proposed or submitted. The amount expended to June 30, 1896, was $35,103.85.

When the river was examined in the spring of 1897 it was found that the narrow upstream sections of the channel had so filled up that vessels drawing 8 feet could not pass through, and the lower sections had shoaled in several places to a depth of 11 or 12 feet. The work of restoring the requisite depth was thereupon commenced May 25, 1897, and was still in progress at the close of the fiscal year. The amount of material excavated in the meantime was 16,844 cubic yards. Expenditures during the year amounted to $1,662.49 (including $1,531.45 outstanding liabilities) and were applied mainly to the work of dredging just referred to, which served to reopen the channel to navigation for a draft of 12 feet or under.

Experience shows that the narrow dredged channels can have but little permanence unless the river banks be properly docked or revetted, and it is submitted whether such work should not be done at the cost of the city of Port Huron, or the owners of water frontage, as a prerequisite to further improvement by the Government.

The following statement indicates the commerce of this river during the past four calendar years, as shown by data compiled from the most reliable information available:

Year.	Number of vessels.	Freight tonnage.	Year.	Number of vessels.	Freight tonnage.
1893	602	182,568	1895	587	111,675
1894	595	120,948	1896	628	189,556

July 1, 1896, balance unexpended		$7,896.15
June 30, 1897, amount expended during fiscal year		131.14
July 1, 1897, balance unexpended		7,765.01
July 1, 1897, outstanding liabilities	$1,531.35	
July 1, 1897, amount covered by uncompleted contracts	4,152.48	
		5,683.83
July 1, 1897, balance available		2,081.18
Amount (estimated) required for completion of existing project		32,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		32,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix K K 13.)

14. Pine River, Michigan.—This river was improved in 1875 by dredging a channel 100 feet wide, 12 feet deep, for a distance of about three-fourths of a mile upstream from the mouth of the river; the cost was $5,000. This channel shoaled up in time, and after an examination of the river called for by the river and harbor act of July 13, 1892, a project for further improvement was prepared under the act of August 18, 1894, and the act of June 3, 1896, appropriated $5,000 for commencing the work. This project provides for dredging a channel 14 feet deep extending about 5,800 feet from the mouth, the width to be 100 feet or 75 feet according to locality. The estimated cost was $10,560.

Work on the new project was commenced September 24 and contin-

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ued until November 16, 1896, resulting in a channel of the prescribed width and depth for a distance of 2,500 feet from the mouth and with a width of 30 feet, 12 feet deep over the remainder of the proposed distance.

The amount expended during the year was $4,452.95, which resulted in increasing the depth from 9 feet to 14 in the lower end and 12 in the upper sections of the improvement.

The appropriation of $5,560, being the balance of the estimated cost, will be required to complete the improvement.

The commerce of this river during the past calendar year, as shown by data compiled from the most reliable information available, amounted to a freight tonnage of 2,683.

July 1, 1896, balance unexpended	$5,000.00
June 30, 1897, amount expended during fiscal year	4,452.95
July 1, 1897, balance unexpended	547.05
Amount (estimated) required for completion of existing project	5,560.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	5,560.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix K K 14.)

15. Belle River, Michigan.—This river was improved, 1880–1885, by dredging a channel 50 feet wide, 13 feet deep to the first bridge and 12 feet to the second one, a total distance of 5,400 feet. The total cost was $14,000, and the principal benefit was to provide a winter harbor for vessels.

The river and harbor act of July 13, 1892, called for an examination of the river, and that of August 18, 1894, for survey and estimate of cost of its further improvement. Project for redredging the channel to a width of 75 feet and depth of 15 feet to the first, and 14 feet to the second, bridge was submitted November 30, 1895, the estimated cost being $21,500.

The act of June 3, 1896, appropriated $5,000 for the work, and operations, commenced June 12, 1897, were still in progress at the close of the fiscal year. The amount excavated was 14,086 cubic yards. The amount expended during the year was $322.72.

In view of the low price at which contract was made for this season's work, an additional single appropriation of $10,000 will suffice to complete the approved project of improvement, thereby making the total cost about $6,000 less than the estimate.

The commerce of this river during the past calendar year, as shown by data compiled from the most reliable information available, amounted to 482 entrances and clearances, with a freight tonnage of 83,287.

July 1, 1896, balance unexpended		$5,000.00
June 30, 1897, amount expended during fiscal year		322.72
July 1, 1897, balance unexpended		4,677.28
July 1, 1897, outstanding liabilities	$1,623.82	
July 1, 1897, amount covered by uncompleted contracts	2,450.54	
		4,074.36
July 1, 1897, balance available		602.92
Amount (estimated) required for completion of existing project		10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix K K 15.)

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16. Clinton River, Michigan.—This is a navigable stream emptying into Anchor Bay, in the northwesterly part of Lake St. Clair, with an original channel depth of about 10 feet, except at shoals, over which but 5 or 6 feet could be carried, and a broad flat at the mouth with a general depth of from 3 to 4 feet. In 1870–71 a channel 9 feet deep, 60 feet wide, and 2,700 feet long was dredged through this flat, but being left without works of protection it soon filled in again. In 1885 a project of general improvement was adopted which provided for a through channel 8 feet deep to Mount Clemens (8 miles upstream), for a pile dike extending across the flat at the mouth to the curve of 10-foot depth in the bay, and for revetments as needed above. The estimated cost, as modified in 1889, was $34,564.

The total expenditure to June 30, 1897, was $60,515.99, of which $25,500 was applied to occasional and scattering work done prior to the adoption of the present approved project in 1885; the expenditure chargeable to the latter was therefore $35,015.99.

As a result of these expenditures, the proposed 8-foot channel was obtained by dredging and kept in a fairly navigable condition by the aid of temporary revetments and occasional redredgings; but the appropriations were at no time sufficient to permit the construction of any protecting works of a permanent character, and in their absence the maintenance of the channel must depend on periodical dredgings.

No work was done on the river between 1893 and June 10, 1897, and the dredged channel had shoaled in the meantime to depths of only 4½ or 5 feet in some places; the work of dredging that was commenced on the last-named date was still in progress at the close of the year, the amount excavated to June 30, 1897, being 8,655 cubic yards. The result of this work was to reopen the channel through the bar at the mouth and for a distance of about 1,200 feet upstream. The balance of funds available at the close of the year will be expended in continuing dredging through the river to Mount Clemens.

The commerce of this river during the past calendar year, as shown by data compiled from the most reliable information available, amounted to 420 entrances and clearances, with a freight tonnage of 31,159.

July 1, 1896, balance unexpended		$14,735.14
June 30, 1897, amount expended during fiscal year		187.13
July 1, 1897, balance unexpended		14,548.01
July 1, 1897, outstanding liabilities	$1,595.60	
July 1, 1897, amount covered by uncompleted contracts	4,701.75	
		6,297.35
July 1, 1897, balance available		8,250.66

(See Appendix K K 16.)

17. Detroit River, Michigan.—Originally the channel at Limekiln Crossing, Detroit River, could not be depended upon for more than 13 feet of water, the ordinary depth being much affected by the direction of the wind.

The original project of 1874 provided for a curved channel 300 feet wide and 20 feet deep through the Limekiln Crossing; but in 1883 this project was modified to secure a straight channel of minimum width of 300 feet; again, in 1886, to increase the width to 400 feet by removing an additional 100 feet from the western (American) side, and in 1888 a further additional width of 40 feet on the western side was authorized, the estimated cost of the whole work being $1,374,500. This channel was completed in 1890 at a total cost of $704,257.34.

The present project, adopted in 1892, contemplates the removal of

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such shoals in Detroit River, between the city of Detroit and Lake Erie, as obstruct navigation. The approved estimate under this project provides for a channel 800 feet wide and 20 feet deep from the head of Ballards Reef to the head of Limekiln Crossing, at an estimated cost of $180,000.

The total amount expended under the present and original projects to June 30, 1896, was $722,967.96, the total estimates for these projects being $884,257.34. At that date the channel had been cleared to a general depth of about 16½ feet.

During the year ending June 30, 1897, $17,406.06 was expended, and resulted in increasing the navigable depth to 17½ feet, the work done being mainly the removal of bowlders.

The approved estimate for this improvement will require material modification, for it does not include all that will be necessary for making a safe channel conforming to the general project of a through waterway with a navigable depth of 20 feet. Such channel has been opened at all other critical parts of the line, and an appropriation of what is required to give the same depth in this locality is urgently needed, in order that commerce may realize the benefits of the large expenditures already made at all other links in the chain.

The following statement indicates the commerce of this river during the past four calendar years, as shown by data compiled from the most reliable information available:

Year.	Number of vessels.	Freight tonnage.	Year.	Number of vessels.	Freight tonnage.
1893	33,165	23,091,899	1895	36,104	25,845,679
1894	34,800	24,263,868	1896	33,290	27,900,520

July 1, 1896, balance unexpended		$70,142.45
June 30, 1897, amount expended during fiscal year		17,406.06
July 1, 1897, balance unexpended		52,736.39
July 1, 1897, outstanding liabilities	$6,864.83	
July 1, 1897, amount covered by uncompleted contracts	38,720.05	
		45,584.88
July 1, 1897, balance available		7,151.51
Amount (estimated) required for completion of existing project		91,257.34
Amount that can be profitably expended in fiscal year ending June 30, 1899		91,257.34

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix K K 17.)

18. Rouge River, Michigan.—This stream originally had a channel depth of from 10 to 17 feet for a distance of about 3 miles above its mouth. Its improvement was commenced in 1888, under a project for securing a regular channel depth of 16 feet, with a width of 240 feet for a distance of 800 feet from the mouth, and thence with a width of 100 feet to the Wabash Railroad Bridge, about 2⅔ miles farther up. The estimated cost was $31,690.39, and the work was completed in 1892.

The total expenditure to June 30, 1896, was $31,012.22.

No work has been done on the river since 1892; but under the provisions of the river and harbor act of June 3, 1896, the section of river heretofore improved was examined in May, 1897, and survey made for estimating the cost of extending the original improvement about 8,000 feet farther upstream. The results of this examination and survey will be presented in a special report at an early date, and for this reason no estimate for additional appropriation is now submitted.

The following statement indicates the commerce of this river during

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the past four calendar years, as shown by data compiled from the most reliable information available:

	Tons.		Tons.
1893	73,732	1895	114,090
1894	47,106	1896	123,495

July 1, 1896, balance unexpended	$10,677.78
June 30, 1897, amount expended during fiscal year	782.23
July 1, 1897, balance unexpended	9,895.55
July 1, 1897, outstanding liabilities	139.00
July 1, 1897, balance available	9,756.55

(See Appendix K K 18.)

19. Turning basin in Rouge River, Michigan.—The river and harbor act of September 19, 1890, called for an estimate for "locating and constructing basin in Rouge River, at a point on the same within 4 miles of its junction with the Detroit River, convenient for the turning and anchoring of vessels." The estimate thereupon submitted was as follows: Three acres of land for site, $4,500; 74,074 cubic yards excavation, $11,111.10; total, $15,611.10. The river and harbor act approved July 13, 1892, appropriated $5,000 for acquisition of land and beginning construction according to this project, but the appropriation has been found too small for purchasing the land needed, and accordingly no work has yet been done or expenditure made.

It is now submitted as doubtful whether the construction of the proposed basin will be really necessary, for private parties have already constructed slips opening into the river, and others will undoubtedly follow that will supply openings opposite which vessels will be able to find turning room. If, however, the plan of constructing a turning basin is to be adhered to, work should not be commenced until all the money required to complete it has been appropriated. It is therefore suggested that the construction of the turning basin be abandoned, for the present at least, and that the money already appropriated be made available for general dredging in the Rouge River.

July 1, 1896, balance unexpended	$5,000.00
July 1, 1897, balance unexpended	5,000.00

(See Appendix K K 19.)

20. Removing sunken vessels or craft obstructing or endangering navigation.—Wreck of schooner Bruce.—The schooner *Bruce* was sunk by striking a bowlder in St. Marys River October 17, 1895, and abandoned by the owner.

After due notice, as required by law, contract was entered into on November 28, 1896, for the removal of the wreck. The work was completed on December 20, 1896, at a total cost of $781.93, including superintendence, printing, etc. No property of any value was saved.

(See Appendix K K 20.)

EXAMINATION MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The preliminary examination of *Huron River, Michigan*, from mouth to the point of crossing by the Michigan Central Railroad, required by the act of June 3, 1896, was made by the local engineer, Lieut. Col. G. J. Lydecker, Corps of Engineers, and report thereon submitted July 13, 1897. It is the opinion of the local officer, concurred in by this office, that this river is not worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 87, Fifty-fifth Congress, first session. (See also Appendix K K 21.)

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IMPROVEMENT OF RIVERS AND HARBORS ON LAKE ERIE WEST OF ERIE, PA.

This district was in the charge of Col. Jared A. Smith, Corps of Engineers.

1. Monroe Harbor, Michigan.—Before improvements were made the Raisin River flowed by a circuitous channel and emptied into Lake Erie at a point about 1¼ miles south of the present river mouth. The deepest water at the mouth was then but 5 feet.

A project of improvement was adopted to dredge a canal 4,000 feet long, 100 feet wide, and 10 feet deep across the neck of the swampy peninsula; to protect the canal by a revetment of piles, waling pieces, and sheet piling, and to extend two piers from the mouth of the canal to a depth of 10 feet in the lake.

The city of Monroe subsequently made a further improvement by constructing a canal 1,400 feet long, with same cross section and revetment as the first, across the neck of a large bend in the river. The natural and artificial waterway thus formed from the lake to the wharves makes a very direct channel 2½ miles in length, known as the harbor of Monroe. The improvement was completed many years ago, and since that time all expenses have been for maintenance.

The total cost of construction and maintenance to June 30, 1896, was $240,437.08.

The result has been a mid-channel depth of 9 feet or more from the lake to the wharves, where the depth is but 8 to 9 feet, with a bottom of solid rock.

Expended in the last fiscal year, $96.52.

Of this amount $60 was for expense of keeping a record of water levels and the balance was for contingent expenses of office.

The estimate for completion of project is the unappropriated balance of an estimate made in 1886 and 1891 for repairs then needed. It is recommended that this small amount be made available in one appropriation. Expenditures for extending the improvement by dredging or otherwise are not recommended.

July 1, 1896, balance unexpended	$5,078.19
June 30, 1897, amount expended during fiscal year	96.52
July 1, 1897, balance unexpended	4,981.67
July 1, 1897, outstanding liabilities	15.00
July 1, 1897, balance available	4,966.67
Amount (estimated) required for completion of existing project	11,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	11,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix L L 1.)

2. Toledo Harbor, Ohio.—In 1866 a project was adopted for improving Toledo Harbor by dredging in the channels of deepest water through Maumee Bay to a depth of 12 feet. The project was amended from time to time by increasing the depths until 1887, when the old channel, which was very indirect, had been dredged to a depth of 16 feet. The channel originally had depths ranging from 8½ to 12 feet.

In 1887 a project was adopted in compliance with previous acts of Congress for a straight channel through Maumee Bay. The line was so taken as to utilize the old channel as far as possible, and it was planned for a depth of 17 feet over a bottom width of 200 feet. Estimated cost, including dikes or other protection to channel, was $1,875,000.

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The acts of July 13, 1892, August 18, 1894, and June 3, 1896, authorized extending the improvement up the Maumee River. The dredging of channels 400 feet wide and 18 feet deep over two shoals known as "The Crossing" and the "Lake Shore Shoal," each about 4,000 feet long, has therefore been added to the project, but no addition has been made to the estimated cost.

The project for straight channel has been amended by increasing the width of outer section, about 3 miles long, to 300 feet.

Total expended upon all channels and for all purposes, 1866 to June 30, 1896	$1,459,749.30
Expended on old channels, 1866 to 1890	724,332.61
Expended since adoption of project for straight channel, 1887 to June 30, 1896	735,416.69

As a result the straight channel has been dredged to full depth and width throughout a length of nearly 8 miles, and the depths have been maintained and somewhat increased by redredging.

During the last year the United States dredge *Maumee* pertaining to the improvement has completed the dredging of channels at "The Crossing" and at "Lake Shore Shoal," and has widened the entrance to straight channel near the mouth of the river.

A contract was let in September, 1896, after public advertisement inviting proposals, for widening the outer part of straight channel from 200 feet to 300 feet. Work under the contract was commenced October 6, 1896, and continued to the end of the year, except from November 22 to May 16, when work was suspended for the winter. The widening on north side has been nearly completed and that on the south side has been commenced. The contract requires work to be completed on or before June 30, 1898.

In June, 1897, a complete hydrographic survey of the channel was made and the results have been platted in order to study the conditions of dredging and maintenance. The results are reported in full by the officer in charge of the improvement.

The sundry civil act of Congress approved June 4, 1897, required "a survey and estimate of cost of deepening and widening the straight channel in Maumee River and Bay, with a view to obtaining and permanently securing a channel of uniform width of four hundred feet and twenty feet deep at low water."

Necessary instructions for the survey have been given and the report and estimate will be submitted at as early a day as practicable.

The commerce of Toledo is large, and is increasing.

The officer in charge of the improvement explains the necessity for constructing a small steamer for surveys and supervision at various harbors on Lake Erie.

July 1, 1896, balance unexpended		$162,450.70
June 30, 1897, amount expended during fiscal year		39,042.42
July 1, 1897, balance unexpended		123,408.28
July 1, 1897, outstanding liabilities	$11,902.78	
July 1, 1897, amount covered by uncompleted contracts	62,550.80	
		74,453.58
July 1, 1897, balance available		48,954.70

Amount (estimated) required for completion of existing project	980,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	300,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix L L 2.)

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3. Port Clinton Harbor, Ohio.—The harbor of Port Clinton, Ohio, is formed by a part of the Portage River near its mouth where it flows into Lake Erie. Previous to 1870 the entrance to the harbor had no reliable depth exceeding 5 feet, and the available depth inside the bar did not exceed 7 feet.

The river and harbor acts of March 2, 1867, and July 11, 1870, required an examination or survey of Port Clinton Harbor with reference to its improvement.

The channel was first improved by dredging to a depth of 8 feet, but protections were found necessary to prevent refilling the channel with sand.

In 1875 a plan was adopted to protect both sides of the channel from the shore line to deep water in the lake. The harbor is at the extreme southern point of a bay in the south shore of the lake, where the water is not deep and the entrance to the harbor not exposed to heavy seas, so that a protection consisting of sheet piling supported by piles and waling pieces was sufficient for most of the work; but the pierhead on east side and 720 feet of outer part of west pier were of a stronger type. The estimated cost was $90,000.

The piers had been extended to a depth of 10 feet in the lake in 1883, and no further extension was considered necessary.

The channel has since been dredged to a depth of 10 feet over a width of 100 feet between piers, and a width of 200 feet inside the shore line; the channel depths have since been maintained without dredging. The piers have been strengthened with a riprap of stone.

The amount expended to June 30, 1896, was $75,629.69.

The woodwork of the piers and channel revetment is now in very bad condition from decay, and it has not been considered advisable to renew it.

After advertising for proposals, a contract has been made with the lowest bidder to reenforce the piers by adding to the stone riprap; in fact, making foundation for permanent piers of stone, which can be built very cheaply because of their small dimensions.

During the last fiscal year a substantial wood and wire fence has been constructed on the boundary line of the point purchased by the United States between the harbor and the lake.

The channel depth of 10 feet is sufficient for the necessities of the place.

July 1, 1896, balance unexpended		$12,370.31
June 30, 1897, amount expended during fiscal year		216.73
July 1, 1897, balance unexpended		12,153.58
July 1, 1897, outstanding liabilities	$31.50	
July 1, 1897, amount covered by uncompleted contracts	10,000.00	
		10,031.50
July 1, 1897, balance available		2,122.08
Amount (estimated) required for completion of existing project		15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix L L 3.)

4. Sandusky Harbor, Ohio.—The harbor of Sandusky is in the lower part of Sandusky Bay.

Originally the harbor depths were only those of the shallow water of the bay, which was in general 8 to 12 feet deep. The largest draft

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of vessel which could enter the bay and reach the wharves did not exceed 10 feet at the mean water level.

In 1826 an appropriation of $400 was made for a survey, but the first appropriation for improvement was made in 1844.

Previous to 1888 the plans of improvement consisted in deepening the best natural channels by dredging.

In 1888 the maximum depth in channels from the lake to the city front was 15 feet, and most of it was narrow and indirect. A plan was then adopted for a direct channel 200 feet wide and 17 feet deep from the east end of the dock channel to the "Deep Hole" at Cedar Point, a length of 1¾ miles. This straight channel was completed in 1894, but the channels on city front and outer bar had not maintained the depths previously secured.

In compliance with requirement in the river and harbor act of August 18, 1894, a project and estimate was submitted for dredging inside channels 200 feet wide and 17 feet deep, and channel over the outer bar 300 feet wide and 18 feet deep, and to construct a jetty and dike to confine the currents and maintain the depth over the bar. Estimated cost was $255,000.

Total expended, improving Sandusky Harbor, 1844, to June 30, 1896, $430,889.90.

The channels in the bay then had depths of 16 to 17 feet; along the city front the width was 60 to 100 feet; width of straight channel had been somewhat reduced by action of waves and passing steamers.

In August, 1896, after public advertisement, contracts were let to lowest bidders for dredging and for commencing construction of jetty from Cedar Point. Amount allotted for dredging was $15,000 and for jetty $25,000.

At the end of the fiscal year dredging under the contract was nearly completed. Vessels drawing 17 feet had no difficulty in passing the entire length of the channels, which have a turning basin at the extreme inner end.

The jetty of brush mattresses and heavy stone has been extended about 800 feet from Cedar Point.

The benefit to the channels during the last year has been great and has resulted in an increase of freights by water.

The river and harbor act of June 3, 1896, required a survey of the bar at the mouth of the harbor and an estimate of the cost of improvement. The survey has been completed, and report and estimate will be submitted as soon as maps can be platted.

July 1, 1896, balance unexpended		$45,902.10
June 30, 1897, amount expended during fiscal year		16,222.65
July 1, 1897, balance unexpended		29,679.45
July 1, 1897, outstanding liabilities	$6,381.45	
July 1, 1897, amount covered by uncompleted contracts	20,367.00	
		26,748.45
July 1, 1897, balance available		2,931.00

Amount (estimated) required for completion of existing project	185,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	185,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix L L 4.)

5. Huron Harbor, Ohio.—In 1826 the mouth of the river was closed by a sand bar. Improvements were then undertaken to confine the

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currents and protect the channel by parallel piers of crib work filled with stone.

The piers have been extended and repaired and the channel was deepened by dredging as necessities required, without any radical change in the original plan. Methods of construction have, however, been recently much improved.

The amount expended to June 30, 1896, was $162,055.58.

The resulting channel has generally exceeded 17 feet in depth over a width of 75 feet or more, decreasing to about 10 feet near the piers, which are from 130 feet to 140 feet apart.

A large part of west pier is in very bad condition, so that the only judicious repair is an entire renewal. During the last fiscal year a section of west pier, commencing at outer face of old light-house pier and extending inward, was removed and replaced with entirely new materials, save a portion of the stone and iron which were utilized. The work was carried on by hired labor and purchase of material without formal contract, and is an example of exceptionally cheap construction, with results equally exceptional for their excellence.

The channel is now in good condition, with a depth exceeding 17 feet in the middle over a width of about 75 feet, becoming gradually less deep toward the sides.

The officer in charge of the improvement does not recommend any further extension of the piers, but presents reasons for concluding that the same amount expended in constructing outer breakwaters converging toward the lake will be productive of far better results.

All expenses of last fiscal year were for maintenance.

July 1, 1896, balance unexpended	$10,218.13
June 30, 1897, amount expended during fiscal year	9,470.22
July 1, 1897, balance unexpended	747.91
Amount (estimated) required for completion of existing project	117,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	75,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix L L 5.)

6. Vermilion Harbor, Ohio.—Vermilion Harbor is formed by the part of Vermilion River at and near its mouth, about 35 miles west of Cleveland Harbor.

In 1836, when improvements were commenced, there was less than 2 feet of water over the bar at the mouth of the river. The project for improvement consisted of parallel piers of timber crib work filled with stone, extending across the bar, 125 feet apart.

Work of construction and repairs upon the piers was continued at irregular intervals until 1874, when they had reached a depth of about 12 feet in the lake, the east pier being 1,075 and the west pier 1,125 feet in length. Since 1874 no additions have been made to length of piers. Rock and other material between piers and into the lake was subsequently removed to a depth of 14 feet. The channel has varied in depth, but is rarely less than 12 feet.

Since 1879 nine appropriations, aggregating $19,000, have been made, and all save the small balance now on hand has been expended for repairs and renewal of parts of piers.

Expended for all purposes to 1879	$113,701.28
Expended for maintenance, 1880 to June 30, 1896	15,011.56
Total expenditures to June 30, 1896	128,712.84

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The condition of the piers and the reason why the appropriation of August 18, 1894, had not then been expended was quite fully explained in the Annual Report of Chief of Engineers, 1896, page 2935.

From September 1 to November 24, 1896, a section of east pier 90 feet long (three old cribs) was removed and entirely rebuilt upon the solid rock. The construction was carried on by hired labor, making purchases of material at the lowest prices, obtained through advertising for proposals by circular letter.

Expended in last fiscal year, $3,544.62.

The new work is next inside of the crib on which the lighthouse stands. That crib is in fair condition and may be made to last for several years. The part of west pier from new work to the shore, about 1,000 feet, is in very bad condition, and must be renewed if the harbor is to be maintained. It may, however, last a few years longer. The inner 750 feet of east pier is in such bad condition that the timber of a large part of the superstructure has rotted away and the stone has fallen into the river.

The amount of $2,000 estimated for completion of project is simply the unappropriated balance of an estimate made sixteen years ago for repairs then needed. It is entirely insufficient now to repair the piers.

Repairs, to be effective, should cover the entire rebuilding of about 1,000 feet of east pier and more than 700 feet of west pier, besides repairs of the crib on which the lighthouse stands.

The depth of water in the channel generally exceeds 12 feet at mean lake level.

The commerce of Vermilion is very small.

July 1, 1896, balance unexpended	$3,989.44
June 30, 1897, amount expended during fiscal year	3,544.62
July 1, 1897, balance unexpended	444.82
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	2,000.00

(See Appendix L L 6.)

7. *Black River (Lorain) Harbor, Ohio.*—Improvements of this harbor were commenced under an appropriation of $7,500 by act approved May 23, 1828, when the mouth of the river was obstructed by a sand bar, leaving but 3 feet depth of water. The plan of improvement was the same as for other river mouths on Lake Erie—parallel piers of timber cribs filled with stone.

The piers have been repaired, rebuilt, and extended from time to time as necessity arose, and the channel and bar have been dredged at various times, but no radical modification of the original project has been adopted. The method of construction has, however, been changed and improved in the most recent works.

The total expenditures to June 30, 1896, were $262,122.72.

As a result the piers had been extended to a depth exceeding 16 feet in the lake, and mid-channel depths were, in general, 16 feet or more, though the channel has at times been dredged to greater depths. At the beginning of the fiscal year the channel had shoaled, and dredging was much needed. A dredge was employed from July 14 to November 10, removing the material to a depth of 19 feet and a width of 150 feet.

The channel is now sufficient for all present necessities of the place, but the older parts of piers are in very bad condition.

The balance of the appropriation of $30,000 by act of June 3, 1896,

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will be expended in rebuilding a section of west pier 396 feet in length and such additional work of maintenance as may be done with available funds. The section of pier is now under construction by hired labor, and purchase of materials by informal contract after inviting proposals by circular letter.

At the end of last fiscal year the timber work of the new part of pier 396 feet long in a single crib was about six courses high. All the timber and iron have been purchased and paid for.

The harbor would be more properly designated as the harbor of Lorain. The city of Lorain has developed rapidly within three years. The extensive steel plant is now being supplemented by other industries, and a large sum of money is being expended by the city and by corporate enterprises improving the river inside the shore line.

The river and harbor act of June 3, 1896, authorized and directed that a survey of the harbor be made and a cost of improvement be estimated with a view to providing better access to the harbor and safety to boats therein. The survey has been completed and maps platted. The report will be submitted at an early day.

July 1, 1896, balance unexpended	$30,082.05
June 30, 1897, amount expended during fiscal year	17,425.94
July 1, 1897, balance unexpended	12,656.11
July 1, 1897, outstanding liabilities	471.96
July 1, 1897, balance available	12,184.15
Amount (estimated) required for completion of existing project	38,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	38,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix L L 7.)

8. Cleveland Harbor, Ohio.—Previous to 1825 the mouth of the Cuyahoga River had no permanent location, but varied between points more than three-fourths of a mile apart. This condition was caused by a sandy bar which formed from the east side and made a ridge or sand spit, forcing the channel to westward and sometimes closing the mouth entirely. The water would subsequently break through in another place when the flow was sufficient to raise it above the top of the bar.

In 1826 the spit extended westward, so that the mouth of the river was about 700 feet west of its present location. The plan of improvement was to rectify the channel line so that it would lead directly into the lake and to make the location permanent by the construction of piers extending across the bar and into the lake on each side. The old channel was obstructed where it bent westward and the current of the river was forced across the sand spit nearly in the prolongation of its natural course above.

The piers were repaired, rebuilt, and extended, and channel was deepened by dredging from time to time until 1875, when the total expenditure was $346,881.61.

In compliance with the river and harbor act of March 3, 1875, a project was adopted for a breakwater in 5 fathoms of water.

The total expense for construction and maintenance of piers and channels and construction and maintenance of breakwaters to June 30, 1896, was $1,636,612.87.

The west breakwater was completed in 1883 and had a total length of 7,130 feet, including shore arm, besides a spur of 100 feet near the harbor entrance.

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East breakwater was 2,490.5 feet long, besides a spur 118 feet long near the entrance.

At the beginning of the fiscal year work was in progress under contract for removing 450 feet of old east pier outside of harbor line and replacing it with a new pier having timber substructure filled with stone and a stone and concrete superstructure. The new pier, 322 feet long, was completed November 30, 1896.

Owing to shoaling in the channel and on front of wharves east of entrance a dredge was employed from July 10 to September 10 deepening the channels to 20 feet. Extensive repairs have been made to breakwaters during the year.

The river and harbor act of June 3, 1896, required a survey with a view of determining the advisability of changing the plan of the breakwater. The survey for this purpose was completed in the season of 1896 and the map has been platted. A report will be submitted as early as practicable.

The same act authorized a modification of previous projects by widening the river at its mouth and renewing the superstructure of west breakwater with concrete masonry. The making of contracts for the entire work of improvements at Cleveland Harbor was also authorized at an expense not exceeding $1,354,000.

Under the provisions of law proposals were invited by public advertisement for removing old superstructure of west breakwater and constructing a new one of concrete masonry; also to strengthen cribs and sheathe the face of substructure. A contract for that work has been executed. Contractors are now actively engaged obtaining plant and materials preparatory to commencing operations and continuing as far as may be done with the funds made available by the sundry civil act of June 4, 1897.

Delay in letting contract for the other parts of project authorized by law has been caused through the difficulty experienced by the city of Cleveland in obtaining title to be transferred to the United States for the land which must be removed in the river widening. The amount covered by contract already concluded is $413,843.78, based on estimated amounts of material. The amount available for application on the contract is $350,000.

Proposals will be invited and contracts let for the remainder of work not exceeding a total of $1,354,000 as soon as practicable.

July 1, 1896, balance unexpended		$117,018.74
Amount appropriated by sundry civil act approved June 4, 1897		350,000.00
		467,018.74
June 30, 1897, amount expended during fiscal year		47,179.95
July 1, 1897, balance unexpended		419,838.79
July 1, 1897, outstanding liabilities	$36.31	
July 1, 1897, amount covered by uncompleted contracts	413,843.78	
		413,880.09
July 1, 1897, balance available		5,958.70
Amount (estimated) required for completion of existing project		924,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		450,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix L L 8.)

9. Fairport Harbor, Ohio.—The harbor of Fairport is in the Grand River, which was originally navigable for small vessels about 2½ miles

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above its mouth, and has been made navigable for large vessels about 1½ miles from the end of piers. In 1825, when the improvement was undertaken, the mouth of the river was closed by a sand bar.

The project originally adopted was to construct parallel piers of timber crib work 200 feet apart across the bar into the lake. Until 1896 the only additions to the project were those made necessary by increased depth of water required, so that the expenditures were for the necessary surveys and examinations of channel, construction and repair of piers, and for removing bars by dredging; the latter item has been very large.

The expenditures to June 30, 1896, were $364,669.21.

The last extension of the piers was made in 1893. The resulting channel depths between piers have exceeded 18 feet, but the bars formed by action of the lake outside the ends of piers have at times reduced the depths to 13 or 14 feet; the bars across the channel have, however, been removed without delay, so that but little inconvenience has resulted to navigation.

In the fall of 1896 and spring of 1897 the dredging through the bar required the removal of 56,995 cubic yards of sand at an expense of $9,954.62 for dredging and inspection, in addition to cost of examinations of the channel and other contingent engineering.

The expenditures of the fiscal year were for liabilities of previous year, dredging the channel, and for office and engineering contingencies.

The river and harbor act of June 3, 1896, appropriated $30,000, and provided that of the amount the sum of $20,000 shall be applied toward construction of a breakwater according to the project submitted April 3, 1896. The project for breakwaters has, therefore, been approved. The project is for two converging breakwaters, and dredging the area between to a depth of 20 feet, at an estimated cost of $510,000.

It is necessary to reserve a sum not less than $10,000 for dredging the channel and for other emergencies. The expenditure of $20,000 alone upon the breakwaters would build too small a section to be of any practical service, while the proportional cost would be increased. The recommendation of the officer in charge of the improvement to defer construction of the breakwaters until additional funds are available has therefore been approved.

Fairport Harbor is an important port for transporting iron ore and grain, and for shipping coal.

July 1, 1896, balance unexpended	$41,204.32
June 30, 1897, amount expended during fiscal year	10,933.55
July 1, 1897, balance unexpended	30,270.77
Amount (estimated) required for completion of existing project	480,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	250,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix L L 9.)

10. Ashtabula Harbor, Ohio.—Previous to 1826 the natural conditions at the mouth of the river were varied under the action of freshets and storms on the lake. In that year the depth of water over the bar was but 2 feet and the general depth of the rock bottom at the shore was but 9 feet below the water surface. Improvements were then commenced by confining the channel over the bar between piers of timber cribs filled with stone 168 feet apart. The piers were repaired and extended and the channel was deepened by dredging the sand and soft

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rock as the increasing necessities of navigation required, without modification of the general plan, until 1891.

In 1891 a project was adopted to widen the outer part of channel to 213 feet, to extend piers to a depth of 22 feet in the lake, and to excavate the rock bottom to a depth of 20 feet.

The total expenditures from 1826 to June 30, 1896, were $564,465.37.

The outer part of channel had been widened as planned and most of the rock and overlying material had been removed to a depth of 20 feet; the part of rock remaining was about 300 feet long and 50 feet wide, over which the depth was about 17 feet.

The work of rock removal was in progress at the beginning of the last fiscal year. Piers had been extended to a depth of 16 feet in the lake. The deepening of channel under contract was completed July 31, 1896. It was, however, considered necessary to remove the remaining rock and other material to a depth of 20 feet in the channel as far as the county bridge. A supplementary contract was therefore concluded to complete the removal of rock and overlying material at the same price as in the original contract. Work under the second contract was completed June 14, 1897. The entire rock in channel between piers and as far as the county bridge has now been removed to a depth nowhere less than 20 feet, including all overlying material. Any further dredging in the channel will be merely the removal of such material as may be brought down the river or otherwise be deposited over the rock.

The river and harbor act of June 3, 1896, appropriated $50,000 for improving Ashtabula Harbor, and provided that "not less than forty thousand dollars shall be applied toward the construction of breakwaters according to a project submitted in the Annual Report of the Chief of Engineers for eighteen hundred and ninety-five." The project is for construction of two breakwaters converging toward the lake in such manner that the action of seas on the lake will prevent the formation of a bar at the entrance.

A contract for construction of 432 feet of west breakwater has been executed with the lowest bidder after advertising. The framing of the timber work is well advanced and the part under contract will be completed before the end of the working season.

The tonnage of Ashtabula Harbor is about 4,000,000 tons per annum. The breakwaters are much needed; their construction will not only be more rapid but more economical if built under ample appropriations.

July 1, 1896, balance unexpended		$97,935.84
June 30, 1897, amount expended during fiscal year		44,209.36
July 1, 1897, balance unexpended		53,726.48
July 1, 1897, outstanding liabilities	$187.82	
July 1, 1897, amount covered by uncompleted contracts	43,139.63	
		43,327.45
July 1, 1897, balance available		10,399.03
Amount (estimated) required for completion of existing project		480,600.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		480,600.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix L L 10.)

11. Conneaut Harbor, Ohio.—The improvement of Conneaut Creek was commenced under an appropriation approved March 2, 1829, for improving the creek "by removing the bar at the mouth of the same."

Appropriations for "Improvement of Conneaut Creek," "Removing

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obstructions at Conneaut Creek," and for "Improvement of Conneaut Harbor," were made at intervals until 1880, seventeen appropriations having an aggregate of $112,629.39.

The business of the place in 1880 was so small that no further appropriations were made until 1892.

The old works had not been planned with reference to width and depth of channels now required, and in 1892 they were more in the nature of obstructions to be removed than works to be continued. The channel depths were originally but 2 feet under ordinary conditions. The improvements to 1880 had resulted in depths of about 8 feet, which were increased to 11 feet under very favorable conditions, in the narrow channel.

Under the acts of July 13, 1892, and February 24, 1893, a project was adopted for extending parallel piers 200 feet apart into the lake to a depth of 17 feet and dredging the channel between piers at a total estimated cost of $500,000; the total expenditures, 1829 to June 30, 1896, were $192,448.47, and the expenditures on project of 1893 to June 30, 1896, were $79,819.08.

A part of west pier 400 feet long and 24 feet wide had been constructed by contract, and a part of east pier 600 feet long and 18 feet wide, and a pile revetment 526 feet long inside of shore line had been constructed by hired labor and purchase of materials by contract. The channel and bar had been dredged and extensive repairs had been made both to the pier built by contract and to old pier. The channel had a depth of about 18 feet over a width of 100 feet.

The Pittsburg, Shenango and Lake Erie Railway Company first improved the channel by dredging in 1892, and the first ore received was 1,130 gross tons on the 3d of November, 1892. In 1896 the total of receipts and shipments amounted to nearly half a million tons.

Most of the work of dredging channel had been done by the railway company, which is now expending a large amount in making facilities for transfer of ore and coal.

The river and harbor act of June 3, 1896, appropriated $40,000 for continuing the improvement, and provided that "not less than twenty thousand dollars shall be applied toward the construction of a breakwater according to the project submitted March twenty-fourth, eighteen hundred and ninety-six."

The project is for construction of two breakwaters a total length of 2,200 feet, so arranged as to prevent the formation of bars at the outer entrance. Also to continue the piers to a depth of 17 feet and to dredge to a depth of 20 feet. The estimated cost in addition to previous work was $530,000, which was equivalent to an estimate of $610,000 in 1893 for a harbor of 20 feet depth and 26 feet deep at entrance.

The construction of a section of breakwater 282 feet long was commenced April 1, 1897, materials having been purchased by contract. At the end of the year one crib 144 feet in length was nearly ready to be sunk in position. A small expenditure was made during the year for repairs to piers.

Large enterprises have now combined to make Conneaut Harbor a leading port for transfer of iron and coal. Extensive wharves and slips are now in process of construction. It is anticipated that the commerce of the harbor will be vastly increased within a year, and the harbor protections now planned will be greatly needed.

Of the funds appropriated by act of June 3, 1896, $35,000 was applied to breakwater construction and $5,000 reserved for repairs and maintenance.

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July 1, 1896, balance unexpended		$40,180.92
June 30, 1897, amount expended during fiscal year		1,696.54
July 1, 1897, balance unexpended		38,484.38
July 1, 1897, outstanding liabilities	$13,268.45	
July 1, 1897, amount covered by uncompleted contracts	7,788.00	
		21,056.45
July 1, 1897, balance available		17,427.93

Amount (estimated) required for completion of existing project	495,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	495,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix L L 11.)

EXAMINATION MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The preliminary examination of *Raisin River, in Monroe County, Mich.*, from the mouth to Government Canal to the wharves, required by the act of June 3, 1896, was made by the local engineer, Lieut. Col. (now Col.) Jared A. Smith, Corps of Engineers, and report thereon submitted August 26, 1896. Work is being carried on at present at this locality under appropriations for improving Monroe Harbor, Michigan, and it is the opinion of the local officer that the cost of any extension of improvements heretofore planned would vastly exceed the probable benefit to the commerce of the country. The maintenance of the piers, canal revetment, and lighthouse involves all the expense which can be justified by the present or probable commerce or business of the place. The views of the local officer are concurred in by the Chief of Engineers. The report was transmitted to Congress and printed in House Doc. No. 81, Fifty-fourth Congress, second session. (See also Appendix L L 12.)

IMPROVEMENT OF ERIE HARBOR, PENNSYLVANIA, AND OF CERTAIN RIVERS AND HARBORS IN WESTERN NEW YORK.

This district was in the charge of Maj. Thomas W. Symons, Corps of Engineers. Division Engineers, Col. (now Brig. Gen.) John M. Wilson, Corps of Engineers, to February 11, 1897, and Col. G. L. Gillespie, Corps of Engineers, since that date.

1. Erie Harbor, Pennsylvania.—In its original condition the harbor of Erie was landlocked, the only entrance being to the east; the channel was narrow and tortuous, variable in position, with a depth of about 6 feet.

The original project, prepared in 1823, provided for closing all of the eastern end of the harbor by means of a breakwater, in which should be an opening 200 feet wide, and for extending to deep water in the lake two parallel piers, one on each side of the opening. This project is substantially in force at the present time, except that the piers are 360 feet apart.

The project also includes the necessary work of dredging to keep the channel open, making the necessary repairs to existing structures, and maintaining Presque Isle Peninsula.

The original estimated cost of the existing project is an uncertain quantity. The cost of future work depends so largely upon contingencies that it is impossible to state it with any degree of accuracy.

The cost of pier extension, rendered necessary by sand movements, can be definitely estimated, but the repairs and dredging can not.

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The total amount expended for the improvement, preservation, and maintenance of Erie Harbor and Presque Isle Peninsula to June 30, 1896, was $898,681.33.

The results obtained were to establish and maintain a good entrance channel of a depth of 18 feet and at least 275 feet wide, and a commodious deep harbor inside.

The results obtained during the fiscal year ending June 30, 1897, were to maintain the channel and harbor as above. There was some shoaling of the channels, which was remedied by dredging under contract.

A new survey of the harbor was made during the year, and the report, submitted May 24, 1897, with plans and estimates for future improvement, was printed as House Doc. No. 70, Fifty-fifth Congress, first session, and is also herewith as Appendix M M 8.

The commerce of Erie is large and increasing. During the year 1896 there were 3,100 arrivals and departures of lake vessels, with an aggregate tonnage of 3,634,842 tons. The receipts are principally iron ore, wheat, flour, corn, lumber, and copper, and the shipments principally coal. The tonnage of the port has more than doubled during the past ten years, which is largely due to its having been kept in most excellent condition by the Government.

The following table, compiled from the reports of the Chief of Engineers, gives the combined number of arrivals and departures and the tonnage of arriving and departing vessels for the past ten years:

Year.	Arrivals and departures.	Tonnage.	Year.	Arrivals and departures.	Tonnage.
1887	1,221	1,451,767	1892	2,180	2,409,945
1888	2,111	1,852,601	1893	1,677	1,701,542
1889	2,488	2,351,485	1894	2,687	3,069,545
1890	2,694	2,480,853	1895	2,936	3,323,672
1891	2,437	2,343,566	1896	3,100	3,634,842

July 1, 1896, balance unexpended		$47,902.79
May 12, 1897, repayment to appropriation		1.00
		47,903.79
June 30, 1897, amount expended during fiscal year		11,781.58
July 1, 1897, balance unexpended		36,122.21
July 1, 1897, outstanding liabilities	$600.00	
July 1, 1897, amount covered by uncompleted contracts	6,550.90	
		7,150.90
July 1, 1897, balance available		28,971.31
Amount (estimated) required for completion of existing project		(*)
Amount that can be profitably expended in fiscal year ending June 30, 1899		(*)
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix M M 1.)

2. Harbor at Dunkirk, N. Y.—The harbor at Dunkirk is naturally a simple indentation of the south shore of Lake Erie. It lies between Point Gratiot on the west and Battery Point on the east. Between the two points is a distance of about 9,600 feet, and the maximum breadth of the bay behind the line of the two headlands is 3,600 feet. The general depth of water in the bay was about 10 feet. The bay is

*New project reported.

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underlaid with rock at an average depth of 15 to 16 feet. The object of the improvement is to form an artificial protected harbor in the indentation or bay above described.

The original project was adopted in 1827, and, with its subsequent modifications, provided for the construction of a pier running out from the west shore of the indentation and a detached breakwater parallel with the pier and about 2,000 feet distant from the city front. An opening between the two structures provided a harbor entrance through which a channel leading to the docks was to be deepened to 13 feet.

In 1870 a Board of Engineers recommended a plan which provided for a detached breakwater 2,860 feet long, one part of which, 2,300 feet long, was to be nearly parallel with the shore, the other part to be nearly parallel with the axis of the channel entrance and 560 feet long.

This breakwater and the pier already built were to form the harbor, and the old channel was to be enlarged to 170 feet wide and 13 feet deep.

All the works now existent at Dunkirk have been built in accordance with this plan. The project adopted by Congress and provided for by the river and harbor act of June 3, 1896, consists of completing the breakwater as before planned by the addition of 360 feet to its eastern end, and adding the channel arm 560 feet long, and in addition thereto dredging an entrance channel and a harbor basin, containing in all about 65 acres, to a depth at mean lake level suitable for vessels drawing 16 feet.

The river and harbor act of June 3, 1896, appropriated $10,000 for the work, and authorized the Secretary of War to enter into contract for the whole work, at a cost not to exceed $398,258.

The total amount expended on the harbor to June 30, 1896, was $551,721.52. At this date the works consisted of an unfinished detached breakwater, 1,991 feet in length, a part of the 2,300-foot section provided by the project, a pier 1,410 feet long, exclusive of light-house crib, and a channel 100 feet wide and 13 feet deep. The breakwater and pier consist of timber work, the cribs being filled with stone and decked over.

Contract was made April 15, 1897, with Edward J. Hingston for the work authorized by the river and harbor act of June 3, 1896, consisting of the excavation of about 555,000 cubic yards of material, of which about 475,000 cubic yards is mud, sand, gravel, etc., and 80,000 cubic yards is rock; the replacement of 680 linear feet of the decayed superstructure of the west pier with concrete; the building of a timber crib structure along the eastern edge of the proposed entrance channel; and the extension of the breakwater 310 feet to the east, to consist of a timber and stone foundation, surmounted by a concrete and stone superstructure; all at an estimated cost of $321,386.85. Work under the contract was begun May 5, 1897, and continued to the close of the year. No appreciable change in the conditions has yet been made.

The commerce at Dunkirk by water is very limited at the present time. During the year 1896 the arrivals and departures of vessels numbered 42, with a total tonnage of 12,160 tons. The receipts by lake were 9,968 tons of lumber, and there were no shipments.

The following table gives the total of the arrivals and departures

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and the tonnage of the vessels arriving and departing for the past ten years, as compiled from the reports of the Chief of Engineers:

Year.	Arrivals and departures.	Tonnage.	Year.	Arrivals and departures.	Tonnage.
1887	32	9,992	1892	58	13,756
1888	32	12,302	1893	137	19,158
1889	68	17,189	1894	76	18,763
1890	100	22,496	1895	69	15,650
1891	96	24,465	1896	42	12,160

July 1, 1896, balance unexpended		$12,357.86
Amount repaid to appropriation May 12, 1897		.50
Amount appropriated by sundry civil act approved June 4, 1897		398,258.00
		410,616.36
June 30, 1897, amount expended during fiscal year		11,696.71
July 1, 1897, balance unexpended		398,919.65
July 1, 1897, outstanding liabilities	$400.00	
July 1, 1897, amount covered by uncompleted contracts	314,105.81	
		314,505.81
July 1, 1897, balance available		84,413.84

(See Appendix M M 2.)

3. Buffalo Harbor, New York.—Buffalo Creek was the original harbor of the port of Buffalo. In its original condition it was shallow and was closed by a gravel bar for most of the year. The original project for the improvement of this harbor was adopted in 1826 and provided at first for the construction of piers on the north and south sides of Buffalo Creek. Subsequently a masonry sea wall running south from the shore end of the south pier was proposed and built. In 1868 a detached breakwater, about 2,500 feet lakeward from the lighthouse, to extend south a distance of 4,000 feet, was proposed and adopted. In 1874 it was determined to extend this breakwater to a total length of 7,600 feet. This breakwater has now its fully proposed length, the final extension of 806 feet having been built in 1893. It runs parallel with the shore and about half a mile distant from it. In 1874 it was also proposed to build a shore arm to the breakwater, the inshore end to consist of pile work near shore and crib work in the deeper water. Upon reaching the 16-foot contour line in the lake this shore arm was planned to continue in a direction making an angle of about 45 degrees with the shore and to overlap the south end of the breakwater, leaving an opening of 150 feet. In 1886 a project was approved for replacing the superstructure, as fast as it became badly decayed, with concrete. To date, 3,879.13 feet has been so replaced.

In 1895 a new project was adopted for the improvement of Buffalo Harbor. The project consists of the abandonment of the shore arm and the extension of the breakwater from its present southern end to Stony Point. The report of the Board and details of its plans are published in the Report of the Chief of Engineers for 1895, page 3153 et seq. The river and harbor act of June 3, 1896, adds to the project of the Board of Engineeers by providing for the construction of a further length of the sand-catch pier, extending it to the established pierhead line.

The project now in force for the improvement of Buffalo Harbor is:

(1) To maintain existing structures, making the requisite minor repairs, and replacing the wooden superstructure of the breakwater with concrete when necessary.

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(2) To build an extension of the breakwater from its present southern end to Stony Point, leaving the necessary openings for the convenience of commerce.

(3) To extend the sand-catch pier to the established pierhead line.

As long as only minor repairs are needed, the cost of maintenance of existing structures is estimated at $5,000 per year. There is a stretch of 1,015 feet of wooden breakwater lying between the two concreted portions which will soon require to have its superstructure replaced with concrete. This is the portion which gave the most trouble in building and where the foundation and superstructure is most insecure. This concrete superstructure must soon be built, and its cost is estimated at $125 per foot, or for the 1,015 feet, $126,875. To rebuild this superstructure and provide for minor repairs, an estimate of $136,875 is presented.

The total amount expended by the United States on the improvement of Buffalo Harbor to June 30, 1896, was $2,710,831.02, with the result of obtaining and maintaining a very good harbor. The principal features are north and south piers at the mouth of Buffalo Creek, in which most of the business of the port is done; also an outer breakwater 7,608.6 feet long, built of timber and stone.

A sea wall 5,400 feet long was also built along the lake shore south of the harbor entrance, and a sand-catch pier of piles and stone 870 feet long built out from the shore.

In accordance with the authority contained in the river and harbor act of June 3, 1896, the work of extending the breakwater to Stony Point and the sand-catch pier to the pierhead line was advertised, and bids opened on November 30, 1896.

The contract (which is a continuous one) was awarded to Hughes Bros. & Bangs.

Under this contract the work of dumping stone in the rubble mound breakwater was started May 19, 1897, and has continued ever since. Work on the sand-catch pier was started May 25, 1897, which work is still under way.

In accordance with provisions of the river and harbor act of June 3, 1896, contracts have been entered into with Hughes Bros. & Bangs, amounting to $1,638,795, for the completion of the Buffalo Breakwater. It appearing desirable and necessary to secure some of the required stone from the Canadian shore opposite Buffalo, the question of duty on such stone was considered in advance of making the contract, and, after correspondence with the Treasury Department and in accordance with the advice given, the contract was made in three parts, one for the purchase of the stone by the United States in Canada. The specifications of contract contains the clause, "the United States assuming all responsibilities for the duties which may be assessed against the stone." A formal permit was then issued by the Secretary of the Treasury for the free admission of the stone.

The contractors have opened their quarry in Canada, built docks, and made extensive arrangements for an immediate commencement of work. The decision of the Secretary of the Treasury that such stone can not under the new tariff law be admitted free of duty prohibited any further work, for the War Department has no funds at its disposal available for the payment of duties.

This unfortunate condition of affairs necessitated a suspension of an important work ordered by Congress unless some arrangement could be made by which the work could be continued, but the Treasury officials finally consented to permit the further entry of the material pending a decision of the question of duty which is now presented to

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Congress for consideration, with recommendation that such action be taken as will permit the free entry of such Canadian stone as may be furnished under existing contract for the construction of the Buffalo Breakwater.

The commerce of Buffalo is enormous. During the year the arrivals and departures of vessels by lake and river aggregated in number 10,446, and in tonnage 11,053,206.

The arrivals and departures of canal boats by the Erie Canal were 11,576. The principal receipts by lake and river were wheat, corn, flour, oats, iron ore, lumber, copper, pig iron, glucose, lard, and pork. The total receipts amounted to 7,272,067 tons.

The shipments by lake were principally coal, sugar, salt, and cement, and aggregated 2,800,052 tons.

For comparison the following table is given, showing arrivals and departures by lake and canal, and the tonnage for the last five years:

Year.	Lake.		Canal.	
	Arrivals and departures.	Tonnage.	Arrivals and departures.	Tonnage.
1892	11,485	9,518,072	10,920	1,007,000
1893	10,055	9,494,649	15,450	1,586,238
1894	9,664	8,789,902	13,242	1,437,293
1895	9,975	9,612,423	9,092	709,346
1896	10,446	11,053,206	11,576	1,570,743

Assuming that the number of arrivals of canal boats equaled the number of clearances, the grand total of the commerce of Buffalo carried on by lake, river, and canal for the season of 1896 is as follows:

Arrivals and departures by lake and river	10,446
Arrivals and departures by canal	11,576
Total arrivals and departures	22,022
Receipts of freight by lake and river, tons	7,272,067
Shipments of freight by lake and river, do	2,800,052
Receipts of freight by canal, do	398,191
Shipments of freight by canal, do	1,172,552
Total shipments and receipts by water, do	11,642,862

The commerce of Buffalo depends almost entirely upon the work of harbor improvement done by the United States.

July 1, 1896, balance unexpended	$127,164.35
Amount appropriated by sundry civil act approved June 4, 1897	481,250.00
	608,414.35
June 30, 1897, amount expended during fiscal year	11,902.13
July 1, 1897, balance unexpended	*596,512.22
July 1, 1897, outstanding liabilities	$1,500.00
July 1, 1897, amount covered by uncompleted contracts	1,754,267.22
Amount (estimated) required for completion of existing project	1,718,750.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	618,750.00
Amount that can be profitably expended in fiscal year ending June 30, 1899, for maintenance	136,875.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix M M 3.)

*This work is carried on under a continuing contract.

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4. Tonawanda Harbor and Niagara River, New York.—In its original condition the navigation of the Niagara River from Lake Erie to Tonawanda was obstructed by several reefs and shoals which materially limited the draft of the vessels traversing it; the water in the harbor between Tonawanda Island and the main shore was shoal, and the river in some places had a very swift current.

The object of the improvement undertaken is to provide a navigable channel from the head of Niagara River at Lake Erie to the north line of the village of North Tonawanda, and to dredge Tonawanda Harbor to a depth permitting its use by vessels with 16-foot draft.

The adopted project of 1888 is to remove obstructions so as to make a channel 400 feet wide and 18 feet deep, which includes work at the following places:

1. On the Horseshoe Reef at the entrance to Niagara River.
2. On the shoal at the head of Strawberry Island.
3. At a few shoal places abreast of the lower end of Rattlesnake Island.
4. The full width of the river between Tonawanda Island and the mainland along the entire front of Tonawanda.

This project was approved in 1888.

The cost of the work estimated in 1891 was $1,152,987.93. This does not include the work necessary between Tonawanda Island and the north line of the village of North Tonawanda. The amount expended on the general project up to June 30, 1896, was $295,968.20.

At this time the channel through the Horseshoe Reef had been completed; the Strawberry Island Reef had been dredged to a depth of 18 feet for a width of 160 feet over about two-thirds of its length; the remaining one-third had a depth of 16½ feet.

Tonawanda Harbor had been dredged 20 feet wide to a depth of 18 feet along nearly all the length of the Tonawanda Island front.

The results of operations during the year ending June 30, 1897, were the completion of the 18-foot channel for a width of 180 feet through the whole length of the Strawberry Island Reef; the excavation of a channel 18 feet deep and 200 feet wide through the shoal at the foot of Tonawanda Island, and the removal of the most troublesome ridges from Tonawanda Harbor.

The commerce of Tonawanda is large. During the year 1896 there were entered and cleared 2,592 lake craft, with a tonnage of 917,444 tons. The receipts were principally lumber, iron ore, and limestone, and aggregated 1,015,396 tons. The shipments from Tonawanda amount to very little.

The following table gives the entrances and clearances at Tonawanda for the last three years:

	1894.	1895.	1896.
Vessels entered ..... number..	849	949	1,311
Vessels cleared ..... do....	830	951	1,281
Entering vessels ..... tons..	418,438	425,105	466,297
Clearing vessels	403,350	441,602	455,000
Articles received by lake in vessels, rafts, etc ..... tons..	838,267	894,408	1,015,396
Canal clearances ..... number..	2,258	2,120	2,062
Shipments by Erie Canal ..... tons..	436,260	403,358	384,889
Lumber shipments by Erie Canal ..... feet B. M..	202,110,990	195,886,000	185,580,352

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July 1, 1896, balance unexpended		$54,031.80
May 12, 1897, repayment to appropriation		1.00
		54,032.80
June 30, 1897, amount expended during fiscal year		42,488.96
July 1, 1897, balance unexpended		11,543.84
July 1, 1897, outstanding liabilities	$400.00	
July 1, 1897, amount covered by uncompleted contracts	7,893.22	
		8,293.22
July 1, 1897, balance available		3,250.62

Amount (estimated) required for completion of existing project	802,987.93
Amount that can be profitably expended in fiscal year ending June 30, 1899	250,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix M M 4.)

5. Niagara River from Tonawanda to Port Day, N. Y.—Port Day is the inlet to the old hydraulic power canal at Niagara Falls. It is not and never has been a practical port of commerce, owing to shallow water and its proximity to the rapids at the head of Niagara Falls.

From Port Day up, the river in front of the city of Niagara Falls is very shallow and with rock bed until Conners Island is reached. Between Conners Island and the main shore is a snug little harbor with about 5 acres of a depth of 12 feet at mean river stage and with a maximum depth of about 18 feet.

Above the head of the island there was a shoal with a least depth on it of 7½ feet at mean stage. Above this shoal very good water existed until Cayuga Island was reached. From this island to Tonawanda shoals exist, which require dredging to give a channel of 12 feet depth at low river stage.

The original project for the improvement of this portion of the Niagara River contemplated the formation of a channel 300 feet wide from Tonawanda down to Conners Island, 200 feet wide from Conners Island to Grass Island, and increasing from 200 to 400 feet wide from Grass Island to Port Day, and construction of an embankment with rock excavated from the channel, extending from Conners Island to Port Day, so as to inclose the lower end of the channel. A channel of 12 feet depth was proposed, although it was incidentally estimated that a channel of 8 feet depth should be first provided, which could be enlarged as an increase of commerce might demand. The cost of the proposed channel, 8 feet deep at mean lake level (6 feet at low water), was estimated at $257,829.

The river and harbor act approved July 13, 1892, appropriated $20,000 for the commencement of work upon the 8-foot channel.

By act of Congress of August 18, 1894, provision was made for "Improving Niagara River from Tonawanda to Port Day, with a view of obtaining a channel of 12 feet depth to Schlossers Dock." The amount available under this act was $30,000.

The project as it now stands is, therefore, to provide a channel 12 feet in depth at low water and 200 feet in width from Schlossers Dock back of Conners Island through to Tonawanda by the American channel of the Niagara River. This project is recognized by the river and harbor act of June 3, 1896.

The cost of completing the project was estimated in 1892 to be $230,000. The cost of the work was reestimated last year at $180,000, and it is now determined that the work can be completed for much less than this amount, viz, $50,000, making the total cost of the work contemplated by the project $95,000.

Up to June 30, 1896, there had been expended on the project

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$26,703.48. By this time a channel 12 feet deep at mean river level and 200 feet wide was completed the entire length of the Conners Island Shoal, about 1,700 feet.

During the year 1897 a hydrographic survey from Tonawanda to Schlossers Dock was made, and a 200-foot channel was located from Tonawanda to Conners Island.

On June 21, 1897, drilling was begun on Cayuga Island Shoal, under contract, and continued to the end of the fiscal year. None of the rock has yet been removed.

The commerce involved in the improvement is very small. During the year the total arrivals and departures were 410, all of which were small excursion boats. Whatever benefit the works confer will be upon future commerce.

July 1, 1896, balance unexpended	$18,296.52
June 30, 1897, amount expended during fiscal year	2,233.07
July 1, 1897, balance unexpended	16,063.45
July 1, 1897, amount covered by uncompleted contracts	14,307.75
July 1, 1897, balance available	1,755.70
Amount (estimated) required for completion of existing project	50,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix M M 5.)

6. Wilson Harbor, New York.—Wilson Harbor is at the mouth of Twelve Mile Creek, a small stream flowing into Lake Ontario. In its original condition there was a depth of water inside the mouth sufficient for ordinary-sized lake craft, but it was closed by a bar upon which there was ordinarily but about 1 foot of water.

The present project was submitted in 1873, and proposed to extend piers to the 12-foot curve in Lake Ontario, and to dredge a channel 12 feet deep between the piers and from the shore end of the piers to deep water in the creek.

The original estimated cost of the work, as made in 1873, was $90,000. This was increased in 1877 to $100,000.

The amount expended upon the project to June 30, 1896, was $64,978.51. With this money there had been built two piers at the harbor entrance and a shore protection. The piers are prolongations of piers built by private parties in 1846. At present the west pier is 832 feet long and the east pier 850 feet long. There is also a shore protection for the east pier. This is 360 feet long.

The channel was dredged in 1889 to a minimum depth of about 9 feet, but had shoaled since that time.

During the year 1897 the channel was dredged 80 feet wide to its full depth of 12 feet from the lake to the docks in the harbor, and minor repairs were made on the piers.

The commerce of Wilson by water is very small, and is practically confined to a few excursion boats, which come mainly from Toronto.

July 1, 1896, balance unexpended	$5,000.00
May 12, 1897, repayment to appropriation	.50
	5,000.50
June 30, 1897, amount expended during fiscal year	4,984.41
July 1, 1897, balance unexpended	16.09
Amount (estimated) required for completion of existing project	30,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix M M 6.)

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7. Removing sunken vessels or craft obstructing or endangering navigation.—At the beginning of the fiscal year 1897, $300 pertaining to the indefinite appropriation of June 14, 1880, was on hand, having been allotted June 5, 1896, for the removal of the wrecks *Pacific* and *Annie Laurie* from Erie Harbor, Pennsylvania.

Notices inviting proposals for the work were issued July 10, 1896, and proposals opened July 20, 1896, the lowest received being $350. This was rejected as being excessive, and on July 29, 1896, the work was let for $300.

The work was completed August 4, 1896, both wrecks being entirely removed. Final payment was made August 28, 1896.

EXAMINATION AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The preliminary examination and surveys of the following localities, required by the act of June 3, 1896, were made by the local engineer, Maj. Thomas W. Symons, Corps of Engineers, and reports thereon submitted through the division engineer, Col. G. L. Gillespie, Corps of Engineers:

1. Preliminary examination for a ship canal by the most practicable route, wholly within the United States, from the Great Lakes to the navigable waters of the Hudson River, of sufficient capacity to transport the tonnage of the lakes to the sea.—Major Symons submitted report of examination June 23, 1897. He states that there are three possible routes for a ship canal entirely within the United States from the Great Lakes to the Hudson River. The first-mentioned route extends from Lake Erie to Lake Ontario by canal and the Niagara River; thence through Lake Ontario to Oswego; thence up the Oswego and Oneida rivers to Oneida Lake and through Oneida Lake; thence across the divide to the Mohawk River, and down said river to the Hudson at Troy. This is designated as the Oswego route. The second route follows the line of the Erie Canal from Lake Erie and the Niagara River through to the Hudson. This is designated as the Erie Canal route. The third route coincides with the first from Lake Erie to Lake Ontario, running thence through Lake Ontario to the St. Lawrence River, and down said river to some point near Ogdensburg; thence crossing the State of New York to Lake Champlain and up said lake to its head, and thence following in general the route of the Champlain Canal to the Hudson at Troy.

The relative merits of these routes are discussed in the report, and it is the opinion of the local officer that the best route for the contemplated ship canal is the Oswego route; that to build such a canal from the Great Lakes to the ocean by any of the possible routes mentioned would at a rough estimate cost $200,000,000; that to maintain the canal and to keep it and all its structures in repair would cost at a rough estimate $2,000,000 per year, and that such a canal, if constructed, would have no military value. In his opinion the construction of such canal is not a project worthy of being undertaken by the General Government, as the benefits to be derived therefrom would not be properly commensurate with the cost.

Major Symons is also of opinion that the Erie Canal, when enlarged under existing plans of the State of New York, will, if all restrictions imposed by the State upon its use be removed, give commercial advantages practically equal to those that would be given by a ship canal, and that if it be further improved by enlargement to a size sufficient

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for 1,500-ton barges, in the manner suggested by him, such improved canal would enable freight to be transported between the East and the West at a lower rate than by a ship canal navigated by the large lake or ocean vessels. This enlargement of the Erie Canal he considers a project worthy of being undertaken by the General Government, as the benefits to be derived would be properly commensurate with the cost, which is estimated to be approximately one-fourth that of a ship canal.

The cost of the necessary surveys for a ship canal along the Oswego route is estimated at $190,000. An independent survey for the enlargement of the Erie Canal as proposed would cost $125,000. A combined survey to cover the two projects would cost $250,000. Such surveys must precede the preparation of detailed plans and estimates of cost of improvement. The views of the local officer regarding the expediency of the surveys to determine the cost of enlarging the Erie Canal and the location and cost of a ship canal, at the aggregate cost of $250,000, are concurred in by the division engineer.

The report was transmitted to Congress and printed in House Doc. No. 86, Fifty-fifth Congress, first session. (See also Appendix M M 7.)

2. Survey of Erie Harbor, Pennsylvania.—Major Symons submitted report of survey May 24, 1897. The plan of improvement proposed contemplates repairs to and extension of north and south piers, repairs to south breakwater, dredging in entrance channel and harbor, sand catch and shore protection jetties, and encouragement of plant growth on Presque Isle Peninsula. This work, including contingencies and the sum of $20,000 proposed to be reserved for preservation of the peninsula, will, it is estimated, cost $397,000. It is the opinion of the local officer, concurred in by the Chief of Engineers, that the proposed improvement is worthy of being carried out and is justified by the present and prospective interests of commerce. The report was transmitted to Congress and printed in House Doc. No. 70, Fifty-fifth Congress, first session. (See also Appendix M M 8.)

3. Survey of Buffalo entrance to Erie Basin and Black Rock Harbor, New York.—Major Symons submitted report of survey May 18, 1897. The plan of improvement submitted contemplates the construction of a breakwater 2,300 feet in length, consisting of a timber crib filled with stone and surmounted with a concrete and stone superstructure. The cost of the work is estimated at $248,000. To provide, however, for any change in the type of the structure which may be desirable at the time of beginning construction, four alternate designs for a breakwater are presented. It is the opinion of the local officer, concurred in by the division engineer, that the proposed improvement is worthy of being carried out and is justified by the interests of commerce involved. The report was transmitted to Congress and printed in House Doc. No. 72, Fifty-fifth Congress, first session. (See also Appendix M M 9.)

REPORT UPON HOUSE BILL 7775, FIFTY-FOURTH CONGRESS, FIRST SESSION, PROVIDING FOR WIDENING THE LOCKS OF THE ERIE CANAL, IN THE STATE OF NEW YORK.

By letter of May 9, 1896, inclosing a copy of House bill No. 7775, Fifty-fourth Congress, first session, to make appropriation for widening the locks in the Erie Canal, in the State of New York, in order to permit the passage of modern torpedo boats and other vessels of war of similiar dimensions, the chairman of the Committee on Railways and Canals of the House of Representatives requested the Secretary of War to cause an examination of the subject to be made and to report

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to the committee as to the practicability of the enterprise and the probable cost of the same. The matter was investigated by Maj. Thomas W. Symons, Corps of Engineers, who made report upon the subject December 1, 1896. The report was transmitted to the committee and printed in House Doc. No. 231, Fifty-fourth Congress, second session. (See also Appendix M M 10.)

IMPROVEMENT OF HARBORS ON LAKE ONTARIO, EAST OF OAK ORCHARD, N. Y., AND OF RIVERS AND HARBORS IN VERMONT AND NORTHERN NEW YORK.

This district was in the charge of Maj. W. S. Stanton, Corps of Engineers. Division Engineers, Col. (now Brig. Gen.) John M. Wilson, Corps of Engineers, to February 11, 1897, and Col. G. L. Gillespie, Corps of Engineers, since that date.

1. Harbor at Charlotte, N. Y.—This harbor is in the Genesee River. In its original condition its lower 5 miles had a channel depth of not less than 18 feet, but across the bar at its mouth vessels could carry only 8 feet.

The original project of 1829 was to obtain a channel across the bar, about one-half a mile, 12 feet deep at low water, by constructing two piers, nearly parallel and about 460 feet apart, of cribs of timber ballasted with stones. In 1833 the depth had been increased to 11 feet by the expenditure of $71,161.05. The piers and channel having deteriorated between 1864 and 1871, the piers were restored and the depth of 12 feet at extreme low water obtained by the total expenditure of $285,420.67, which in 1882 had been increased by the cost of maintenance to $312,098.32.

In 1882 (estimate printed in Annual Report of Chief of Engineers for 1881, p. 2437) the project was increased to obtain the depth of 15 feet by extending the two piers a total of 3,250 linear feet and by dredging, at an estimated cost of $154,000.

In 1896, the piers having been extended a total of 1,444 feet, the project was amended to preserve the depth by dredging without further extension of the piers, at least for the present, and in 1897 it was altered to obtain a depth of 16 feet at extreme low water.

The amount expended to June 30, 1896, was $521,845.26.

At that date the depth in the channel across the bar between the piers and in advance of them was 14 feet at extreme low water.

With the amount expended during the fiscal year ending June 30, 1897, the depth has not been increased, but the depth of 14 feet has been preserved.

July 1, 1896, balance unexpended	$14,183.74
June 30, 1897, amount expended during fiscal year	4,777.55
July 1, 1897, balance unexpended	9,406.19
July 1, 1897, outstanding liabilities	50.00
July 1, 1897, balance available	9,356.19
Amount that can be profitably expended in fiscal year ending June 30, 1899	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix N N 1.)

2. Harbor at Pultneyville, N. Y.—This harbor is in Salmon Creek, Wayne County, N. Y. In its original condition the depth was only 20 inches at its mouth.

The project of 1871 was to protect the approach to the creek by build-

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ing two piers in the lake of cribs of timber filled with stones, and to dredge a channel between them extending 900 feet up the creek to a depth of 10 feet at low water, at an estimated cost of $59,000.

In 1875 the material to be dredged was found to be so hard the estimated cost was increased to $71,000.

The amount expended to June 30, 1896, was $74,564.58.

At that date the channel in the creek was 40 to 50 feet wide and 8 feet deep for a length of about 900 feet, but in the channel between the piers the depth was only 6 feet at low water.

The expenditures during the fiscal year ending June 30, 1897, have been applied to maintenance of the piers, but the depth of the channel between them has deteriorated to only 4 feet at low water.

July 1, 1896, balance unexpended	$2,435.42
June 30, 1897, amount expended during fiscal year	2,435.42

(See Appendix N N 2.)

3. Harbor at Great Sodus Bay, New York.—In its original condition the channel connecting this bay with Lake Ontario was wide and impracticable for vessels drawing more than 8 feet.

The original project, adopted in 1829, was to narrow the channel to about 475 feet by a breakwater built along the narrow beach separating the bay from the lake, to confine and protect it between parallel piers extending into the lake, and to dredge it to obtain the depth of 12 feet at low water.

In 1882, when $361,771.80 had been expended, the project was increased to obtain the depth of 15 feet at low water (zero of Oswego gauge) by extending the pier a total of 1,100 linear feet, and by dredging, at an estimated further cost of $100,000. (Annual Report, Chief of Engineers for 1881, p. 2442.)

In 1896, the piers having been extended 539 linear feet since 1882, the project was altered to obtain and preserve the depth by dredging without further extension of the piers into the lake, at least for the present.

The amount expended to June 30, 1896, was $464,344.40.

At that date the controlling depth in the channel was 14 feet at low water.

With the amount expended during the fiscal year ending June 30, 1897, the depth has been increased to 15 feet at low water.

July 1, 1896, balance unexpended	$11,334.39
June 30, 1897, amount expended during fiscal year	6,688.72
July 1, 1897, balance unexpended	4,645.67
July 1, 1897, outstanding liabilities	876.40
July 1, 1897, balance available	3,769.27
Amount that can be profitably expended in fiscal year ending June 30, 1899, for maintenance	12,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix N N 3.)

4. Harbor at Little Sodus Bay, New York.—In its original condition the channel connecting this bay with the lake was about 150 feet wide and 18 inches deep.

The original project of 1854 was to deepen the channel by building two parallel piers from the bar to the 15-foot curve in the lake, and to connect them with the shore by riprap. In 1867 dredging to a depth of 12 feet was added to project.

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The amount expended to June 30, 1896, was $322,997.15.

At that date the controlling depth in the channel was 11 feet, zero of Oswego gauge.

With the amount expended during the fiscal year ending June 30, 1897, the depth has been increased 4 feet, to 15 feet at low water.

July 1, 1896, balance unexpended		$9,944.62
June 30, 1897, amount expended during fiscal year		782.25
July 1, 1897, balance unexpended		9,162.37
July 1, 1897, outstanding liabilities	$3,972.71	
July 1, 1897, amount covered by uncompleted contracts	2,746.30	
		6,719.01
July 1, 1897, balance available		2,443.36
Amount that can be profitably expended in fiscal year ending June 30, 1899		5,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix N N 4.)

5. Harbor at Oswego, N. Y.—In its original condition this harbor, within the mouth of the Oswego River, which could be entered only by vessels of light draft, and in a cove at the mouth formed by the receding shores of the lake, had no protection against the seas from Lake Ontario.

The original project of 1827 was to build a breakwater across the cove of timber cribs filled with stones, and in 1829 it was completed 2,150 feet long at a cost of, approximately, $43,000.

Between 1830 and 1838, 500 feet of masonry superstructure was built.

Between 1866 and 1869, $41,000 was expended in dredging the harbor to the depth of 12 feet at extreme low water.

Between 1868 and 1870 the light-house pier was extended northerly 437 feet.

An outer breakwater 5,800 feet long, west of the Oswego River, was completed in 1881.

In 1881 (act of March 3 and Annual Report of the Chief of Engineers for 1881, p. 2448) a project was adopted to build an east breakwater 2,700 feet long and to dredge the entrance to the harbor to the depth of 15 feet at low water, at an estimated cost of $540,000; 248 feet was constructed in 1881 and removed in 1889.

Two spurs, exterior and at right angles to the outer breakwater, to diminish the waves that sweep across the entrance, were completed 100 feet and 150 feet long in 1885 and 1894.

In 1893 (sundry civil act of March 3) the excavation of rock in the river was added to the project and a further appropriation was made for this purpose in 1894.

In 1896 the project also provided for narrowing the opening made in in the outer breakwater by a storm in 1884, at an estimated cost of $18,500, and for continuing the removal of rock from the Oswego River.

A special report made by Captain Kingman under date of June 8, 1895 (Annual Report of the Chief of Engineers for 1895, p. 3213 et seq.), presents a project for building an east breakwater 1,435 feet long at an estimated cost of $197,000.

The amount expended upon this improvement to June 30, 1896, was $1,831,819.64.

At that date there were 6,720 feet of outer breakwater, spurs, and pier extension, and 2,795 feet of inner breakwater, making 9,515 feet of breakwater intact, forming an outer harbor containing 80 acres where the depth is not less than 12 feet, of which there are 34 acres where the

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depth is not less than 15 feet at low water, and an inner harbor of 9½ acres, with a depth not less than 10 feet at low water.

In the Oswego River above the two islands the area, 15 feet deep at low water, had been enlarged by rock excavation to 3¾ acres.

With the expenditures during the fiscal year ending June 30, 1897, an area of about 3 acres along the south side of the west inner breakwater had been deepened to 15 feet, giving vessels access to 900 feet of the breakwater where they can moor in security in any gales; 40 cast-iron mooring posts have been anchored on the outer and inner breakwaters; a point of rock, which projected about 80 feet into the channel of the river near its mouth, upon which the depth was 12 to 14 feet, has been drilled and blasted to secure 16 feet below low water; in the outer breakwater a breach 35 feet long, that extended 12½ feet below water and was made through the breakwater in December, has been closed, and 173 linear feet of breaches, about 3 feet wide, below water in its outer wall, has been repaired.

July 1, 1896, balance unexpended	$70,811.06
June 30, 1897, amount expended during fiscal year	34,236.44
July 1, 1897, balance unexpended	36,574.62
July 1, 1897, outstanding liabilities	2,766.79
July 1, 1897, balance available	33,807.83
Amount that can be profitably expended in fiscal year ending June 30, 1899 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	70,000.00

(See Appendix N N 5.)

6. Harbor at Sacketts Harbor, N. Y.—In its original condition the use of this harbor was restricted to vessels drawing 6 to 9 feet of water.

The project of 1882 was to deepen it to 12 feet by dredging. In 1884 the project was modified to include a crib of timber ballasted with stone on the shoal in the harbor and connect it with the end of Shiphouse Point by a brush and stone dike, and in 1896 to include two groins of stone to protect the point from erosion.

To June 30, 1896, $15,612.68 had been expended.

At that date the crib and the brush dike had been constructed and about 5 acres had been dredged to the depth of 12 feet, but had shoaled, diminishing the depth to 10 to 11 feet.

With the amount expended during the fiscal year ending June 30, 1897, two stone groins have been built to protect the point from erosion and the harbor has been surveyed.

July 1, 1896, balance unexpended	$4,387.32
June 30, 1897, amount expended during fiscal year	805.61
July 1, 1897, balance unexpended	3,581.71
July 1, 1897, outstanding liabilities	20.00
July 1, 1897, balance available	3,561.71

(See Appendix N N 6.)

7. Harbor at Cape Vincent, New York.—This is a new work. Cape Vincent is in the St. Lawrence River, 2½ miles from Lake Ontario and above a channel difficult to navigate at night. Vessels bound up the lake lie there when weather-bound or when bound down the river at night or in thick weather.

The project, for which $25,000 was appropriated by the act of June 3, 1896, without previous survey, is to build a breakwater parallel to and

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600 feet from the railroad wharf, 1,600 feet long, at an estimated cost of $320,000.

A survey made in 1896 showed that a foundation can be obtained at materially less depth and a breakwater built at less cost parallel to and 500 feet from the railroad wharf, but, until Congress has taken action upon such modified project, which is presented herewith in Appendix N N 7, it was not considered permissible to commence work at the new location.

From a final examination of the foundation in May, 1897, it is estimated that a breakwater of timber cribs, ballasted with stone upon a rubble foundation, can be built at a cost of $200,000.

To June 30, 1896, there had been no expenditure upon the improvement.

With the amount expended during the fiscal year ending June 30, 1897, the bed of the river has been thoroughly examined and a project prepared and submitted.

July 1, 1896, balance unexpended	$25,000.00
June 30, 1897, amount expended during fiscal year	223.00
July 1, 1897, balance unexpended	24,777.00

Amount (estimated) required for completion of existing project	295,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	75,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix N N 7.)

8. Shoals between Sister Islands and Crossover Light, and between Ogdensburg and the foot of Lake Ontario, St. Lawrence River.—(This work was in the charge of Maj. Smith S. Leach, Corps of Engineers, until July 31, 1896.) In its original condition the channel of the St. Lawrence, for 11 miles, extending from Sister Islands Light down to the head of Brockville Narrows, 15 miles above Ogdensburg, was obstructed by 12 shoals (ledges) in the track of vessels, on which the depth was 9½ to 16 feet at low water.

The original project, act of September 19, 1890, was to remove to 18 feet below the zero of the Ogdensburg gauge, Blind Bay, Dark Island, and Haskell ledges, between Sister Islands and Crossover Light, at an estimated cost of $43,305.

In 1893 the project was amended to include the removal of outlying spurs of Haskell Shoal, increasing the cost of the project to $54,772.

The acts of August 18, 1894, and June 3, 1896, authorized expenditure for improving shoals in the St. Lawrence between Ogdensburg and the foot of Lake Ontario, and on October 25, 1894, the project was extended to include the removal of certain smaller shoals.

The removal of Dark Island Shoal and Blind Bay Shoal to the depth of 18 feet below the zero of the Oswego gauge was included in the improvement April 13, 1897.

To June 30, 1896, $19,934.40, had been expended.

At that date Haskell Shoal and spurs, 5 small shoals, and Blind Bay Shoal (except a small part) had been removed to 18 feet below the zero of the Ogdensburg gauge by the excavation of 1,378 cubic yards of rock.

With the expenditures during the fiscal year ending June 30, 1897, the twelve ledges have been surveyed and estimates made of the cost of removing them to 18 feet below the zero of the Oswego gauge, i. e., 17¾ feet below the mean level, during the navigation season of 1895.

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July 1, 1896, balance unexpended	$28,065.60
June 30, 1897, amount expended during fiscal year	1,151.37
July 1, 1897, balance unexpended	26,914.23
July 1, 1897, outstanding liabilities	12.15
July 1, 1897, balance available	26,902.08
Amount (estimated) required for completion of existing project	60,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	60,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix N N 8.)

9. Harbor at Ogdensburg, N. Y.—[This work was in the charge of Maj. Smith S. Leach, Corps of Engineers, until July 31, 1896.] This improvement is to deepen a channel 1⅔ miles in length close along the front of Ogdensburg, on the St. Lawrence and Oswegatchie rivers, and three channels to give access to it across the shoal that separates it from the main channel of the St. Lawrence, one leading to the mouth of the Oswegatchie and two a mile below it.

In their original condition in 1868 the depth at low water was 9½ to 10 feet in the old harbor in the Oswegatchie, 8½ to 12 feet close to the wharves a mile below, 6 feet in the channel along the city front connecting those localities, 9 feet in the channel leading to the mouth of the Oswegatchie, and 10 to 12 feet where the two lower entrance channels have been dredged.

The project of 1868 was to dredge to the depth of 12 feet at the lowest stage of water: (1) The channel of the Oswegatchie River below the bridge between the wharf lines; (2) at the wharves a mile below; (3) a channel 150 feet wide along the city front connecting those localities; and (4) a channel 300 feet wide across the shoal between the channel of the St. Lawrence and the Oswegatchie, and to build, if necessary, 5,500 linear feet of pile-protecting piers, at an estimated cost of $100,000. (Annual Report, Chief of Engineers for 1868, p. 271.) (Completed in 1896 by dredging and without piers.)

The project of 1882 provided for dredging the channel across the shoal to the mouth of the Oswegatchie to 16 feet and all the other channels to 15 feet at extreme low water, at an estimated cost of $76,000. (Annual Report, Chief of Engineers, 1882, p. 2461, and act of August 2, 1882.) Because of the quantity of hardpan met with the estimate for this project was increased to $108,000. (Annual Report, Chief of Engineers, 1885, p. 2295.)

In 1890 the project provided for dredging all the channels to the depth of 16½ feet below zero of Ogdensburg gauge (15 feet below zero of Oswego gauge). (Annual Report of the Chief of Engineers for 1890, p. 2872.) The project of 1897 provides for dredging the two lower entrance channels and adjacent parts of the wharf channel to the depth of 16 feet below the zero of the Oswego gauge, 17 feet at ordinary low water, without exceeding estimated cost of the project of 1890.

To June 30, 1896, the amount expended was $262,344.99.

At that date the controlling depth at low water (zero of Oswego gauge) was: In the channel leading to the Oswegatchie, 11¼ feet; in the Oswegatchie, 15 feet; in the channel along the city front between the Oswegatchie and the lower harbor, 12 feet; in the lower harbor and in its two entrance channels, 14 feet.

By the expenditure during the fiscal year ended June 30, 1897, the lower (easterly) channel to the lower harbor has been deepened to 16 feet.

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July 1, 1896, balance unexpended		$20,010.57
June 30, 1897, amount expended during fiscal year		1,898.41
July 1, 1897, balance unexpended		18,112.16
July 1, 1897, outstanding liabilities	$2,087.89	
July 1, 1897, amount covered by uncompleted contracts	13,826.37	
		15,914.26
July 1, 1897, balance available		2,197.90
Amount (estimated) required for completion of existing project		37,944.44
Amount that can be profitably expended in fiscal year ending June 30, 1899		24,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix N N 9.)

10. Harbor at Burlington, Vt.—[This work was in the charge of Maj. Smith S. Leach, Corps of Engineers, until July 31, 1896.] In its original condition there was no harbor at this locality, and the wharves at Burlington were fully exposed to the seas of Lake Champlain, the greatest exposure being in northwesterly winds, which have a sweep of 15 miles obliquely across the lake.

The original project, adopted in 1836, was to build a breakwater for the protection of the wharves. To 1857, 1,069 linear feet had been built. In 1867, 1874, and 1886, extensions of the breakwater were provided for. Its length June 30, 1897, was 4,163 feet.

August 24, 1894, a project was adopted for replacing the 8 feet above water, which had become decayed and dilapidated, with a superstructure of stone. (Annual Report of the Chief of Engineers for 1895, p. 3237.)

The amount expended on the improvement to June 30, 1896, was $569,379.84.

At that date the wooden superstructure of about 2,200 linear feet of the breakwater was much decayed and dilapidated.

With the amount expended during the fiscal year ending June 30, 1897, 873 linear feet of stone superstructure has been completed and the 323 linear feet of stone superstructure on the detached part of the breakwater repaired.

The breakwater affords good protection to the wharves, except the northerly ones, during northwestern gales.

July 1, 1896, balance unexpended		$19,350.36
June 30, 1897, amount expended during fiscal year		8,982.55
July 1, 1897, balance unexpended		10,367.81
July 1, 1897, outstanding liabilities	$22.85	
July 1, 1897, amount covered by uncompleted contracts	9,500.00	
		9,522.85
July 1, 1897, balance available		844.96
Amount (estimated) required for completion of existing project		230,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix N N 10.)

11. Channel between North and South Hero islands, Lake Champlain, Vermont.—In its original condition this channel was obstructed at its west entrance by a bar through which the channel was but 40 feet wide and 7 feet deep, and at its east entrance by a bar through which the channel was 100 feet wide and 8 feet deep.

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The project of August 11, 1888, was to dredge the channel at the two entrances to a width of 150 feet and depth of 10 feet.

At the close of the fiscal year ending June 30, 1896, $10,000 had been expended.

At that date there was a good channel at the east entrance of the depth and width prescribed in the project, but at the west entrance there was a troublesome bowlder in mid-channel and the channel was 1 to 2 feet shallower in the middle and 2 to 4 feet shallower at its edges and was 25 feet narrower than the project prescribed.

There have been no expenditures upon the improvement since September 30, 1889.

Amount (estimated) required for completion of existing project.....	$4,300.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	4,300.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix N N 11.)

12. Otter Creek, Vermont.—[This work was in the charge of Maj. Smith S. Leach, Corps of Engineers, until July 31, 1896.] In its original condition the available depth in this creek, to the head of navigation at Vergennes, 8 miles from its mouth, was less than 6 feet, and navigation was, in places, seriously impeded by the narrow and tortuous character of the channel.

The original project of 1872 was to deepen and straighten the channel by dredging, at an estimated cost of $58,146.

In 1882 the cost was increased to $73,748.40, to include excavating a channel through a ledge of limestone just below Vergennes.

To June 30, 1896, $50,471.06 had been expended.

At that date the channel, which had been dredged at six localities below Vergennes, had shoaled, and there was a narrow and somewhat tortuous channel through which a draft of not more than 7 feet could be carried to the public landing at Vergennes.

With the amount expended during the fiscal year ending June 30, 1897, a channel 350 feet long, 40 feet wide, and 8 feet deep at low water was excavated through the solid rock above the public landing to the Horse Nail Company's Wharf at Vergennes, and below the public landing a channel 40 feet wide and 8 feet deep was redredged through the shoal at Bull Brook Bend, and the channel at Crittenden Bend was widened by redredging the point.

July 1, 1896, balance unexpended.....	$11,028.94
June 30, 1897, amount expended during fiscal year.....	11,020.46
July 1, 1897, balance unexpended.....	8.48

Amount (estimated) required for completion of existing project.....	12,248.40
Amount that can be profitably expended in fiscal year ending June 30, 1899	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix N N 12.)

13. Narrows of Lake Champlain, New York and Vermont.—[This work was in the charge of Maj. Smith S. Leach, Corps of Engineers, until July 31, 1896.] In its original condition the 15 miles of this waterway extending from the northern terminus of the Champlain Canal at Whitehall, N. Y., northerly to Benson Landing, Vt., had a very narrow and tortuous channel not more than 9½ to 10 feet deep on the shoals at low water.

The original project of 1886 was to obtain a channel with a least width

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of 150 feet, and least depth of 12 feet at low water from the northern terminus of the Champlain Canal at Whitehall to deep water in Lake Champlain below Benson Landing, a distance of 15 miles, by rock excavation and by dredging from Whitehall about 1 mile to the "Elbow," and at Cedar Mountain and Kenyon Bay within 2½ miles of Benson Landing.

The project was extended in 1890 to widen and straighten the channel at South Bay Bend, Beacon No. 3, and Chiltons Bend, all three localities between Whitehall and Benson Landing.

To June 30, 1896, $58,220.25 had been expended.

At that date the channel, which had been dredged to 12 feet, had shoaled in places, restricting the draft that vessels could carry through it to not exceeding 10 feet.

With the amount expended during the fiscal year ending June 30, 1897, the channel in Whitehall Harbor, extending 1 mile to the "Elbow," which had shoaled to 10 feet, had been deepened to 12 feet.

July 1, 1896, balance unexpended	$5,279.75
June 30, 1897, amount expended during fiscal year	5,264.24
July 1, 1897, balance unexpended	15.51
Amount that can be profitably expended in fiscal year ending June 30, 1899 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	25,000.00

(See Appendix N N 13.)

14. Removing sunken vessels or craft obstructing or endangering navigation.—The wreck of an old canal boat loaded with stone was reported as obstructing the navigation of Henderson Harbor, N. Y. Its removal was authorized under the provisions of the act of June 14, 1880, the work being completed November 17, 1896, at a total cost of $300.

(See Appendix N N 14.)

EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The preliminary examinations and surveys of the following localities, required by the act of June 3, 1896, were made by the local engineer, Maj. W. S. Stanton, Corps of Engineers, and reports thereon submitted through the division engineer, Col. (now Brig. Gen.) John M. Wilson, Corps of Engineers:

1. Preliminary examination of Mohawk River, New York, between Rome and the town of Schuyler.—Major Stanton submitted report of examination November 13, 1896. It is his opinion, concurred in by the division engineer and by the Chief of Engineers, that this portion of the Mohawk River is not worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 92, Fifty-fourth Congress, second session. (See also Appendix N N 15.)

2. Preliminary examination of Black River, New York, to harbor at Dexter.—Major Stanton submitted report of examination December 15, 1896. It is his opinion, concurred in by the division engineer and by the Chief of Engineers, that this locality is not worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 143, Fifty-fourth Congress, second session. (See also Appendix N N 16.)

3. Preliminary examination of harbor at Alexandria Bay, N. Y.—Major Stanton submitted report of examination January 9, 1897. It is the opinion of the local officer, concurred in by the division engineer

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and by this office, that the harbor at Alexandria Bay is not worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 205, Fifty-fourth Congress, second session. (See also Appendix N N 17.)

4. Survey of Oak Orchard Harbor, New York.—Major Stanton submitted report of survey January 26, 1897. He presents a plan for making available the depth heretofore obtained at the harbor entrance. It provides for the excavation of a channel 12 feet deep at low water, 150 feet wide, and 430 feet long from the ends of the piers to the 12-foot curve in Lake Ontario, for dredging between piers and near the south end of the west pier, and for repairs to piers. The cost is estimated at $10,500. The cost of obtaining a depth of 15 feet at low water and width of 150 feet from the lake to deep water within the harbor is estimated at $38,000. The division engineer thinks it would be well to make available the depth heretofore gained, at a total cost of $10,500, as estimated above, but believes that any extended improvement of the harbor for the purpose of obtaining a greater depth is a work not worthy of being undertaken by the United States. The views of the division engineer are concurred in by this office. The report was transmitted to Congress and printed in House Doc. No. 281, Fifty-fourth Congress, second session. (See also Appendix N N 18.)

5. Survey of Missisquoi River, Vermont, from Swanton to Lake Champlain.—Major Stanton submitted report of survey January 23, 1897. It is estimated that to excavate to a depth of 4 feet from Swanton to the lake, via the middle mouth of the Missisquoi, would cost $43,000; a 5-foot depth would cost $78,000, and a 6-foot depth $122,000. Considerable expenditure in periodic dredging would be required to maintain the improvement. The middle and eastern mouths of the river can be entered only from Canadian water, and it appears that dredging through the bar at the outlet of the middle mouth would extend a few feet into Canadian territory. The western mouth could be entered without traversing Canadian water, but the improvement of this mouth would increase the estimated cost of the work to $45,586, $82,253, and $127,739 for depths of 4, 5, and 6 feet, respectively. It is the opinion of the local officer, concurred in by the division engineer, that the cost of the proposed improvement, together with that of maintenance, would be greater than is justified by the interests of commerce involved. The report was transmitted to Congress and printed in House Doc. No. 253, Fifty-fourth Congress, second session. (See also Appendix N N 19.)

REPORT UPON HOUSE BILL 8074, FIFTY-FOURTH CONGRESS, FIRST SESSION, PROVIDING FOR WIDENING THE LOCKS OF THE OSWEGO CANAL, IN THE STATE OF NEW YORK.

By letter of May 9, 1896, inclosing a copy of House bill No. 8074, Fifty-fourth Congress, first session, to make appropriation for widening the locks in the Oswego Canal, in the State of New York, in order to permit the passage of modern torpedo boats and other vessels of war of similar dimensions, the chairman of the Committee on Railways and Canals of the House of Representatives requested the Secretary of War to cause an examination of the subject to be made and to report to the committee as to the practicability of the enterprise and the probable cost of the same. The matter was investigated by Maj. W. S. Stanton, Corps of Engineers, who made report upon the subject October 19, 1896. The report was transmitted to the committee and printed in House Doc. No. 231, Fifty-fourth Congress, second session. (See also Appendix N N 20.)

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PACIFIC COAST.

IMPROVEMENT OF OAKLAND HARBOR, CALIFORNIA.

This work was in the charge of Col. Charles R. Suter, Corps of Engineers, having under his immediate orders Capt. Joseph E. Kuhn, Corps of Engineers, to July 26, 1896, and Lieut. Charles L. Potter, Corps of Engineers, since September 5, 1896.

The principal features of this improvement as originally projected are (1) two mid-tide training walls of rubblestone extended from the shore westward into San Francisco Bay about 2 miles; (2) a connection by a canal 1½ miles in length with the estuary of San Leandro; (3) a dam at the mouth of this estuary; (4) dredging of basins and channels to give a depth of 22 feet at low tide, which, at high tide, will accommodate vessels of the largest class.

Two modifications of the original project have been adopted, namely, to increase the width of tidal canal from 300 to 400 feet and to raise the height of jetties from half-tide level to full high water. In the original condition of the entrance the low-water channel depth was about 2 feet, admitting at time of high tide vessels drawing 6 to 8 feet of water.

The total amount appropriated for improving harbor at Oakland, Cal., to June 30, 1896, was $1,804,600, and the total amount expended to that date was $1,772,168.94.

The condition as to facility for navigation on June 30, 1896, permitted vessels drawing 19 feet of water to pass from San Francisco Bay to Oakland at ordinary high water. The low-water depth of 20 feet held over 8,500 feet. There was a depth of 18 or 19 feet over 1,800 feet of length, and for the remaining 8,500 feet the low-water depth was 14 feet. The width of this channel was 300 feet. In the upper basin the channel originally made 200 feet wide and 8 feet deep had shoaled 1.5 feet in three years.

No work was done during the year on the dredged channels, and the depths reported have remained unchanged, except in the case of the channel in the upper basin, which has shoaled 3 inches during the year.

The river and harbor act of June 3, 1896, provided for—

Improving harbor at Oakland, California: Continuing improvement, under existing project, twenty thousand dollars: *Provided*, That contracts may be entered into by the Secretary of War for such materials and work as may be necessary to complete said improvement, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate six hundred and sixty-six thousand dollars, exclusive of the amounts herein and heretofore appropriated.

Owing to the wording of this act, which required the completion of the improvement with the sum designated, it was not considered advisable to attempt any work during the year. The estimates for completing the work were considerably larger than the sum authorized by Congress.

The sundry civil act of June 4, 1897, provides for—

Improving harbor at Oakland, California: For continuing improvement under present limit, two hundred thousand dollars. And the provision of the "Act making appropriations for the construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes," approved June third, eighteen hundred and ninety-six, relating to improving harbor at Oakland, California, is hereby amended to read as follows:

Improving harbor at Oakland, California: Continuing improvement under existing project, twenty thousand dollars: *Provided*, That contracts may be entered into by the Secretary of War for such materials and work as may be necessary to prosecute work on said improvement, to be paid for as appropriations may from time to

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time be made by law, not exceeding in the aggregate six hundred and sixty-six thousand dollars: *Provided further*, That in making such contract or contracts the Secretary of War shall not obligate the Government to pay in any one fiscal year, beginning July first, eighteen hundred and ninety-seven, more than twenty-five per centum of the whole amount hereby authorized to be expended.

It will be noted that the restricting clause relative to completing the work for a specified sum is removed, and hence work will be begun as soon as contracts can be let; but it is proper to add that it is not believed that the work can be completed with the sum remaining to be appropriated under the existing estimate, but that this sum will have to be increased some $325,000.

July 1, 1896, balance unexpended	$32,431.06
Amount appropriated by sundry civil act approved June 4, 1897	200,000.00
	232,431.06
June 30, 1897, amount expended during fiscal year	4,280.28
July 1, 1897, balance unexpended	228,150.78
July 1, 1897, outstanding liabilities	925.00
July 1, 1897, balance available	227,225.78

Amount (estimated) required for completion of existing project	521,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	166,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix O O.)

IMPROVEMENT OF RIVERS AND HARBORS IN CALIFORNIA SOUTH OF SAN FRANCISCO.

This district was in the charge of Maj. Charles E. L. B. Davis, Corps of Engineers, having under his immediate orders Lieut. Charles L. Potter, Corps of Engineers, to September 5, 1896, and Lieut. Herbert Deakyne, Corps of Engineers, since September 14, 1896. Division Engineer, Col. Charles R. Suter, Corps of Engineers.

1. San Luis Obispo Harbor, California.—San Luis Obispo Harbor is 9 miles to the southward and westward of the town of San Luis Obispo, very nearly half way between the harbors of Wilmington and San Francisco. It is a bight of the coast about 18 miles long between Point San Luis on the north and Point Sal on the south. The upper end, where Port Harford is situated, has a wharf, and is the part used for commercial purposes. Whaler Reef, extending nearly half a mile to the southward and eastward of Point San Luis, forms more or less of a natural breakwater, but during the winter season it is exposed to the heavy swell caused by southerly gales.

The original project, approved September 22, 1888, was to construct a breakwater of rough stone on Whaler Reef, extending from Point San Luis to Whaler Island and thence to a point where the outer reef rises above high water. Its length when completed, including the island, was to be nearly 2,000 feet, and it was to be brought up to the plane of mean low water. The estimated cost was $284,989. This project was subsequently modified January 17, 1893, so as to raise the structure up to a height of 6 feet above high water, with a thickness on top of 20 feet and such side slopes as may be assumed under the action of the sea, at an estimated cost of $568,660.

The amount expended up to the close of the fiscal year ending June 30, 1896, was $113,319.45.

On the above-mentioned date the breakwater had been extended out

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to 510 feet beyond Whaler Island and had been brought up to the grade, 6 feet above high water. This made the total length of the breakwater, including the island, 1,091 feet long, leaving 890 feet yet to be completed. This had added greatly to the security of vessels lying at the anchorage and at the wharf at Port Harford, and these advantages will be increased with the prolongation of the breakwater.

During the fiscal year ending June 30, 1897, the breakwater was extended 190 feet, 40 feet of which was brought up to high water and 150 feet up to mean low water.

July 1, 1896, balance unexpended	$61,680.55
June 30, 1897, amount expended during fiscal year	9,300.40
July 1, 1897, balance unexpended	52,380.15
July 1, 1897, outstanding liabilities	24.10
July 1, 1897, balance available	52,356.05
Amount (estimated) required for completion of existing project	393,660.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	150,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix P P 1.)

2. Wilmington Harbor, California.—Wilmington is situated at the head of a small estuary, which has its outlet in the bay of San Pedro, which is 393 nautical miles to the southward of San Francisco.

Previous to the commencement of the improvement, in 1871, there was a depth of less than 2 feet of water at low tide at the entrance.

The original project, approved July 1, 1871, contemplated gaining a depth of 10 feet at mean low tide by constructing 6,700 linear feet of breakwater of sheet piling and crib work filled with stone, at an estimated cost of $400,000, but, owing to the destruction of part of the structure by storms and other causes, the total cost of this project was increased to $555,000.

In 1881 a further project to increase depth of channel from 10 to 15 feet at mean low tide by dredging a reef, and between the jetties raising existing works and extending the jetties to 18 feet of water in San Pedro Bay, at an estimated cost of $291,766, was submitted. But on account of smallness of appropriations and consequent delay in prosecuting the work—preventing proper control over currents and other physical conditions—this amount was found to be inadequate, and in 1886 was increased to $400,000.

In 1894 a project was submitted by the local officer in charge for a channel 18 feet deep at mean low tide, which would permit drafts of 22 to 24 feet at high tide, at an estimated cost of $392,725, and, in obedience to a resolution of the United States Senate, the Chief of Engineers submitted this report on February 7, 1895. The river and harbor act of June 3, 1896, appropriated $50,000 for improving the harbor in accordance with this plan, but with certain provisos regarding expenditures.

Up to the close of the fiscal year ending June 30, 1896, the amount expended on this improvement was $952,132.01, though no appropriation had been made since 1892.

By this expenditure the available channel depth had been increased from 2 feet to 14.5 feet at mean low tide, and as the high tides average nearly 6 feet, vessels drawing over 20 feet could make the entrance.

The river and harbor act of June 3, 1896, provided for the appointment by the President of a Board to decide whether a harbor of refuge should be established at Santa Monica or San Pedro (outer harbor of Wilmington), with the condition that if San Pedro was chosen existing

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appropriations for the Wilmington Harbor should not be expended. The Board having selected San Pedro, the expenditure of existing appropriations is prohibited, and without further action of Congress the presenting of an estimate for the additional sum required for the completion of the improvement of this harbor is not permissible.

July 1, 1896, balance unexpended	$52,867.99
June 30, 1897, amount expended during fiscal year	721.42
July 1, 1897, balance unexpended	52,146.57
July 1, 1897, outstanding liabilities	40.00
July 1, 1897, balance available	52,106.57

(See Appendix P P 2.)

3. San Diego Harbor, California.—San Diego Harbor is just to the northward of the national boundary of Mexico and 482 nautical miles to the southward of San Francisco.

Before the adoption of the present project the work carried on had for its object the preservation of the harbor, which was being injured by the deposit of material brought down the San Diego River during flood stages, and for this purpose a dike was built across the mouth of the river and a new channel excavated, causing the river to empty into False Bay. This work was completed in 1876 at a cost of $79,798.72.

The present project for the improvement of the harbor, approved December 8 and 30, 1890, has for its object the construction of a jetty on Zuninga Shoal at the entrance to the harbor, the maintaining of a channel 24 feet deep at mean low tide and 500 feet wide through the middle ground, and the repairs of the dike. The jetty was to be about 7,500 feet long, extending from Coronado Island out on Zuninga Shoal with a view to gaining 26 feet at mean low tide on the outer bar, where the survey of 1887 showed a depth of 21 feet. The estimated cost of this improvement was $394,400.

The amount expended up to the close of the fiscal year ending June 30, 1896, was $240,523.80, and the jetty had been carried a distance of 2,464 feet seaward up to high water and a foundation course of brush and stone 891 feet farther.

During the fiscal year ending June 30, 1897, the jetty has been extended up to high-tide level out to 3,347 feet and the foundation course 645 feet beyond.

July 1, 1896, balance unexpended	$51,976.20
June 30, 1897, amount expended during fiscal year	49,191.30
July 1, 1897, balance unexpended	2,784.90
Amount (estimated) required for completion of existing project	184,400.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	184,400.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix P P 3.)

EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The preliminary examinations and surveys of the following localities, required by the act of June 3, 1896, were made by the local engineer, Maj. Charles E. L. B. Davis, Corps of Engineers, and reports thereon submitted through the division engineer, Col. Charles R. Suter, Corps of Engineers:

1. Preliminary examination of Colorado River, Arizona.—Major Davis submitted report of examination September 11, 1896. It is his

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opinion, concurred in by the division engineer and by the Chief of Engineers, that the Colorado River is not worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 118, Fifty-fourth Congress, second session. (See also Appendix P P 4.)

2. Preliminary examination of Suisun Creek, California.—Major Davis submitted report of examination September 17, 1896. He states that, while not committing himself to the opinion that the creek is worthy of improvement by the General Government, he does think it worthy of further examination to determine whether any improvement within reasonable limits of cost can be made, and estimates the cost of a survey for the purpose at $600. The views of the local officer are concurred in by the division engineer and by the Chief of Engineers. The report was transmitted to Congress and printed in House Doc. No. 107, Fifty-fourth Congress, second session. (See also Appendix P P 5.)

3. Survey of Alviso Creek, California.—Major Davis submitted report of survey December 11, 1896. The plan of improvement presented provides for a channel depth of 7 feet at low tide from beyond the mouth of the creek up to the town of Alviso. As the tide rises from 7 to 11 feet, this would give a navigation of from 14 to 18 feet at high tide. The estimated cost of the work is $47,855, provided appropriations permit the whole or a greater part of the work to be done under one contract, otherwise the ultimate cost would much exceed this estimate. The local officer does not think that the present commerce of Alviso Creek justifies the expenditure of public funds for its improvement. This opinion is concurred in by the division engineer and by the Chief of Engineers. The report was transmitted to Congress and printed in House Doc. No. 145, Fifty-fourth Congress, second session. (See also Appendix P P 6.)

4. Survey of Redwood Creek, California.—Major Davis submitted report of survey October 28, 1896. The estimated cost of the work outlined in this report is $8,400. The report was transmitted to Congress and printed in House Doc. No. 87, Fifty-fourth Congress, second session. (See also Appendix P P 7.)

5. Survey of Mare Island Strait, California.—Major Davis submitted report of survey November 19, 1896. The plan of improvement recommended by him and by the division engineer is the dredging of a channel 30 feet deep, 800 feet wide across the outer bar, and 600 feet wide through the main channel. The estimate submitted as the cost of this work is $318,950, but the division engineer states that if, as seems entirely probable, hydraulic dredges can be employed and the dredged material be pumped ashore, the estimate of cost can probably be reduced 30 per cent or even more. The report was transmitted to Congress and printed in House Doc. No. 134, Fifty-fourth Congress, second session. (See also Appendix P P 8.)

IMPROVEMENT OF SAN JOAQUIN AND SACRAMENTO RIVERS AND TRIBUTARIES, AND OF RIVERS AND HARBORS IN CALIFORNIA NORTH OF SAN FRANCISCO.

This district was in the charge of Capt. Cassius E. Gillette, Corps of Engineers, having under his immediate orders Lieut. Herbert Deakyne, Corps of Engineers, to September 14, 1896, and Lieut. James J. Meyler, Corps of Engineers, since March 4, 1897. Division Engineer, Col. Charles R. Suter, Corps of Engineers.

1. San Joaquin River, California.—Before improvement the low-water channel to Stockton was only 6 feet in depth and contained several

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sharp bends where navigation was difficult, while the upper river, above Stockton, was navigable but for a few months in the year, during high-water stage, and part of that time for boats drawing not more than 2 feet of water.

The plan for improvement was adopted in 1877 and slightly modified in 1881 and 1888. It had for its object to secure and maintain, by dredging, a channel 9 feet deep at low water and 100 feet wide through the tidal portions of the river and Stockton Slough to Stockton, and a channel in Mormon Slough 4 feet deep at low water and 100 feet wide to Miller's Warehouse; also temporary improvement of the low-water channel of the upper river by dredging, scraping, removal of snags, and the closure or partial closure of Paradise Cut and Laird Slough.

The amount expended on the improvement of this river to June 30, 1896, was $352,556.43.

The following results were obtained to June 30, 1896: Dredging under the approved project was commenced in 1877 and has been carried on each year during the low-water stage of the river. It has given a good low-water channel 9 feet in depth to Stockton. The river has also been straightened by three cut-offs near Devils Elbow—one at Head Reach, a double cut-off in the narrows below Stockton, and a double cut-off at Twenty-one Mile Slough. All the cut-offs made have been self-maintaining, and have shortened the distance to Stockton 4½ miles. The cut-offs at Head Reach and Twenty-one Mile Slough were not completed to full width. Paradise Cut was closed by a dam in 1888, which has since been rebuilt and kept in repair. A dam across Laird Slough was built in 1891, and has since been partly rebuilt and kept in repair.

The amount expended on this river during the fiscal year ending June 30, 1897, was $10,197.44, making the total amount thus far expended on its improvement $362,753.87.

During the past fiscal year a channel of the proper depth has been maintained by dredging.

Commerce on the river is large, important, and increasing. It is carried on 12 steamers, averaging 550 tons; 14 barges, averaging at least 100 tons, and several scow schooners. On the lower river the freight handled during the past season was about 431,736 tons and 30,000 passengers. The existence of this traffic is directly dependent upon the maintenance of the present navigable channel.

The amount required for completion of the existing project is indeterminate.

July 1, 1896, balance unexpended	$78,943.57
June 30, 1897, amount expended during fiscal year	10,197.44
July 1, 1897, balance unexpended	68,746.13
Amount that can be profitably expended in fiscal year ending June 30, 1899	11,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix Q Q 1.)

2. Mokelumne River, California.—In its original condition navigation on this river was difficult on account of numerous snags and overhanging trees, and later on because of shoaling at New Hope Landing and the growing of a point of land opposite that place which interfered with the landing of boats.

The project adopted in 1884 had for its object the removal of trees and snags obstructing navigation. This project was increased in 1892 to include dredging and removal of the point of land opposite New Hope Landing.

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Up to June 30, 1896, $17,108.23 had been expended on the improvement of this river. During the past fiscal year there was expended $3.43, making a total to June 30, 1897, of $17,111.66. No work has has been done during the year.

The commerce on this river is carried on by one steamer of 385 tons draft making regular trips, and scow schooners running at irregular intervals. The total tonnage carried for the year was 38,051 tons.

The amount required for completion of the existing project is indeterminate.

July 1, 1896, balance unexpended	$891.77
June 30, 1897, amount expended during fiscal year	3.43
July 1, 1897, balance unexpended	888.34

(See Appendix Q Q 2.)

3. Sacramento and Feather rivers, California.—Before improvement navigation on these rivers was difficult and dangerous above Sacramento on account of snags, shoals, and rapids. Below Sacramento the river was deep and navigation easy. Since that time the river from the mouth of the Feather down has been badly filled up with mining detritus.

In 1874 a project was adopted having for its object the improvement of the low-water channels of the upper Sacramento and the Feather by removing snags, scraping bars, and the construction of temporary wing dams. No attempt at permanent improvement was contemplated. In 1890 the project was increased to include the closure of Paines Break, a crevasse 1¾ miles below the city of Sacramento. In 1892 it was again increased to include the closure of Jacob Slough, a crevasse above the city of Sacramento, and the treatment of the Yuba River near and above Marysville, a locality in which an enormous quantity of mining detritus had been deposited.

The amount expended on these rivers to June 30, 1896, was $641,316.19.

The work up to June 30, 1896, has been confined to snagging and temporary improvement of the low-water channel, the available depth being 7 feet from Suisun Bay to Sacramento, 4 feet from Sacramento to Butte City, 3 feet from Butte City to Tehama, and 2½ feet from Tehama to Red Bluff, and, in the Feather, 2 feet to Marysville.

The amount expended on the Sacramento and Feather rivers during the fiscal year ending June 30, 1897, has been $37,909.52, making a total amount thus far expended on the improvement of these rivers of $679,225.71.

During the past fiscal year navigation has been maintained at the same depths as before. The snag boat worked on the upper river 168 days, 1,294 snags were removed from the river, 703 linear feet of wing dams built, and 2,047 miles run. The river was surveyed from Red Bluff to Princeton. The work to prevent the threatened cut-off at Parrott Bend near Jacinto was completed. It has, so far, been effectual in preventing the cut-off, but has twice been damaged by floods and been repaired. A small wing dam was built on the Yuba River near Deguerre Point to help confine the river in its old channel. The work of snagging on the upper river has made possible the cheap transportation of enormous quantities of wheat grown in this section.

The commerce on the upper river, including the Feather, is carried on 6 steamboats, averaging 133 tons, and 8 barges, averaging 600 tons, the total tonnage amounting to 148,905 tons. The commerce on the lower river is carried on 9 steamers, averaging 408 tons, and 22

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barges, averaging 600 tons, the total tonnage amounting to 281,355 tons.

Owing to the natural disappearance of shoals on the lower river, the money for their removal was not required and therefore not expended. The balance available will be sufficient to maintain navigation in the Sacramento and Feather rivers until June 30, 1899.

Board for improvement of Sacramento and Feather rivers and their tributaries.—The river and harbor act of June 3, 1896, provides for the appointment of a Board of three Engineer Officers for the purpose of carrying on the improvement of the Sacramento and Feather rivers.

This Board, as constituted during the year, was composed of the same officers as composed the California Débris Commission—Col. Charles R. Suter, Maj. Charles E. L. B. Davis, and Capt. Cassius E. Gillette, Corps of Engineers.

Until this Board has given thorough consideration to and developed a plan of improvement, no new project can be presented. There being a sufficient sum on hand to continue work under existing project for snagging operations, no estimate for the year ending June 30, 1899, is presented.

The amount required for completion of the existing project is indeterminate.

July 1, 1896, balance unexpended	$118,683.81
June 30, 1897, amount expended during fiscal year	37,909.52
July 1, 1897, balance unexpended	80,774.29
July 1, 1897, amount covered by uncompleted contracts	6,372.79
July 1, 1897, balance available	74,401.50

(See Appendix Q Q 3.)

4. Napa River, California.—[This work was in the charge of Maj. Charles E. L. B. Davis, Corps of Engineers, until April 23, 1897.] Napa River had an average low-water depth of 5 feet, with the exception of the bars, where the depth was reduced to less than 1 foot on the crests. The ordinary rise of the tide being 5 feet, there was each day a practicable depth of 6 feet, and vessels of 4-feet draft could navigate the river during that time, which, however, varied from day to day.

The approved project consists in dredging the bars between Carr Bend and Vernon Mills, in the immediate vicinity of Napa City, cutting off projecting points of land so as to obtain a channel 75 feet wide and 4 feet deep at mean low water, and removing obstructions, such as snags, logs, etc.

Work upon this improvement was commenced in 1889, and in that year a channel was dredged through the different bars between Carr Bend and the highway bridge at Third street, Napa City, and the river was cleared of snags. This channel was again dredged in 1891.

Up to June 30, 1896, $21,267.30 had been expended on the improvement of this stream. During the past fiscal year there was expended $70, making a total to June 30, 1897, of $21,337.30. No work was done during the past fiscal year.

The amount of commerce involved in this improvement amounted during the past year to 66,370 tons. This channel being the tidal portion of a silt-bearing stream, dredging does not form a permanent improvement.

The amount required for completion of existing project is indeterminate.

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July 1, 1896, balance unexpended	$4,232.70
June 30, 1897, amount expended during fiscal year	70.00
July 1, 1897, balance unexpended	4,162.70
Amount that can be profitably expended in fiscal year ending June 30, 1899 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	5,000.00

(See Appendix Q Q 4.)

5. Petaluma Creek, California.—Before improvement the channel of this creek was very crooked, and in places dry at low water, navigation depending almost entirely on the tide. Its length was then 18.5 miles.

In 1880 a project was adopted for the improvement of this creek by straightening it by cut-offs and dredging it so as to obtain a channel 50 feet wide and 3 feet deep at low water. In 1892 the project was enlarged to make the channel as deep as funds would permit.

The amount expended on this work to June 30, 1896, was $60,955.66. During the past fiscal year there was expended $4.88, making a total to June 30, 1897, of $60,960.54. No work has been done during the year.

The commerce on this creek is carried on one steamer of 294 tons, and several scow schooners. It consists of grain, fruit, and other agricultural products and manufactured goods. During the past year there is reported to have been carried 116,235 tons.

The amount required for completion of existing project is indeterminate.

July 1, 1896, balance unexpended	$44.34
June 30, 1897, amount expended during fiscal year	4.88
July 1, 1897, balance unexpended	39.46
Amount that can be profitably expended in fiscal year ending June 30, 1899 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	4,000.00

(See Appendix Q Q 5.)

6. Humboldt Harbor and Bay, California.—Before improvement the harbor was obstructed by a curved bar of sand, inclosing the entrance about a mile distant. Across this submerged bar was a channel which was exceedingly shifting, uncertain, and dangerous; its low-water depth has been as much as 25 feet and as little as 9 feet. Its outer end frequently changed in position, the greatest range being about 1½ miles. Vessels were frequently storm bound in the harbor for long periods. There were also numerous shoals within the harbor close to the wharves, rendering it difficult for vessels to reach Eureka, Arcata, and Hookton, the main shipping points on the bay.

In 1881 a project for improving the harbor inside was adopted, with a view to securing, by dredging, a channel 12 feet deep and 200 feet wide to the head of Eureka wharves, and one 10 feet deep and 100 feet wide to Arcata and Hookton. This project was completed in 1884, at a cost of $80,884.69. These channels have since silted up materially, and are again an impediment to commerce.

In 1882 a project was adopted for improving the entrance, with the object of increasing the depth over the bar by constructing a low-tide brush and stone jetty, extending seaward from the end of the south spit for a distance of 6,000 feet. Its estimated cost was $600,000. In 1891 a Board of Engineer Officers recommended the raising of this jetty

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to high tide, and the addition of another, making two low-tide stone and brush jetties nearly parallel, about 2,100 feet apart, starting from the north and south spits, respectively, and extending seaward to the 18-foot contour, with such groins on the inside as might be found necessary during the progress of the work. The north jetty was not to be begun until the completion of the south. The total cost of these jetties, and the necessary bank protection, was estimated at $1,715,115, in addition to the amount, $342,500, already appropriated. In 1892 the project was slightly modified so as to start the north jetty from the end of the dike already built for shore protection, making that a part of the jetty. The construction of the north jetty as far as thought necessary to prevent erosion, without awaiting the completion of the south jetty, was also authorized. The river and harbor act of July 13, 1892, placed the improvement under the continuous-contract system.

The amount expended on this work to June 30, 1896, was $1,134,354.49. Of this, $80,884.69 was for dredging inside of the harbor and $1,053,469.80 for improving the entrance.

Up to June 30, 1896, the trestle and foundation of the north jetty had been completed and the jetty raised to full height for one-fifth of its length. Two spurs had been completed, and a third half done. The trestle and foundation of south jetty had been completed to bent 299, a distance of about 4,800 feet. The jetty had been raised to full height to bent 191, about 3,056 feet, and a spur near bent 127 had been completed. The channel across the bar had been deepened to about 20 feet for a width of 500 feet.

The amount expended on this work during the fiscal year ending June 30, 1897, was $273,507.37, making the total amount thus far expended $1,407,861.86.

During the past fiscal year the north jetty has been completed. The foundation of the south jetty has been completed to bent 341, a distance of 5,456 feet. The jetty has been raised to full height to bent 200 and to low-water mark, or above, to bent 258. The channel across the bar has a depth of 22 feet for a width of 1,000 feet, its axis being somewhat farther north than heretofore. A channel fully as good leads to North Bay, but the channel to South Bay has deteriorated, having been encroached upon by sands driven from the eroded point of the south spit. It is now improving.

The commerce of this harbor is carried on by three steamers plying regularly between San Francisco and Humboldt Bay, and numerous coasting vessels. The total tonnage of vessels arriving and departing during the past year was 387,509 tons.

July 1, 1896, balance unexpended		$410,145.51
Amount appropriated by sundry civil act approved June 4, 1897		350,000.00
		760,145.51
June 30, 1897, amount expended during fiscal year		273,507.37
July 1, 1897, balance unexpended		486,638.14
July 1, 1897, outstanding liabilities	$137,753.48	
July 1, 1897, amount covered by uncompleted contracts	348,884.66	
		486,638.14

Amount (estimated) required for completion of existing project	243,115.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix Q Q 6.)

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EXAMINATIONS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The preliminary examinations of the following localities, required by the act of June 3, 1896, were made by the local engineers and reports thereon submitted through the division engineer, Col. Charles R. Suter, Corps of Engineers:

1. Preliminary examination of Napa River, California, to straighten channel from Napa to a point south of Carrs Bend and to make a cut through Carrs Bend.—Maj. Charles E. L. B. Davis, Corps of Engineers, submitted report of examination September 10, 1896. He considers the locality to be worthy of improvement by the General Government within certain limits of cost, and his views are concurred in by the division engineer. The Chief of Engineers concurs in the opinion of these officers to the extent of advising a survey of the river, estimated to cost $500, upon the results of which a more reliable opinion can be formed as to the scope of the improvement justified by the commerce involved. The report was transmitted to Congress and printed in House Doc. No. 117, Fifty-fourth Congress, second session. (See also Appendix Q Q 7.)

2. Preliminary examination of Petaluma Creek, California, with a view to straightening channel from railroad bridge to Donohue Landing.—Capt. Cassius E. Gillette, Corps of Engineers, submitted report of examination January 2, 1897. He is of opinion, concurred in by the division engineer and by the Chief of Engineers, that Petaluma Creek is not worthy of improvement by the United States in the manner indicated in the act. The report was transmitted to Congress and printed in House Doc. No. 209, Fifty-fourth Congress, second session. (See also Appendix Q Q 8.)

3. Preliminary examination of Humboldt Harbor, California, with a view to dredging same along city front.—Captain Gillette submitted report of examination June 30, 1897. It is assumed by him that Eureka is the city referred to in the provisions of the act, and he is of opinion, which is concurred in by the division engineer and by the Chief of Engineers, that the locality is worthy of improvement by the United States. No survey is necessary for the purpose of preparing plan and estimate of improvement. The report was transmitted to Congress and printed in House Doc. No. 84, Fifty-fifth Congress, first session. (See also Appendix Q Q 9.)

IMPROVEMENT OF RIVERS AND HARBORS IN OREGON AND OF LOWER COLUMBIA RIVER, OREGON AND WASHINGTON.

This district was in the charge of Capt. W. L. Fisk, Corps of Engineers, having under his immediate orders Lieut. C. A. F. Flagler, Corps of Engineers. Division Engineer, Col. Charles R. Suter, Corps of Engineers.

1. Port Orford Harbor, Oregon.—River and harbor act of June 3, 1896, contains the following item:

Improving Port Orford Harbor, at Grave Yard Point, Oregon, according to plan recommended by Captain Thomas W. Symons, of the Corps of Engineers, as per House Document Numbered Three hundred and thirteen, Fifty-third Congress, third session, January thirtieth, eighteen hundred and ninety-five, to cost not to exceed two hundred and three thousand three hundred and thirty-six dollars, and the unexpended balance of the appropriation heretofore made March third, eighteen hundred and seventy-nine, for the establishment of a harbor of refuge on the Pacific Coast is hereby transferred to be expended on this improvement, if in the opinion of the Secretary of War the interests of commerce demand such expenditure.

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No action has been taken by the Secretary of War upon this item, and until he decides that "the interests of commerce demand such expenditure" no money is to be expended for work at this locality under the terms of the act.

This act also provides for a survey of Port Orford Harbor, Oregon, with estimate of cost of improvement and importance to shipping and commerce.

It is expected that report of results of this survey will be presented to Congress at its approaching session.

Amount appropriated by act of June 3, 1896, being unexpended balance of appropriation of March 3, 1879, for harbor of refuge on Pacific Coast.	$140,858.52
July 1, 1896, balance unexpended	140,858.52

(See Appendix R R 1.)

2. Coquille River, Oregon (general improvement).—The entrance to the Coquille River was originally by a narrow and tortuous channel skirting the south headland for some distance outside the bar at the mouth. This channel, both outside the bar and for a distance of one-half mile inside, was studded with rocks, while the portion across the bar was constantly shifting in position. The low-water depth was but about 3 feet, being increased to a little over 7 feet at mean high tide. At long intervals the channel would break through the north spit and run directly out to sea south of Rackcliffe Rock, making the entrance comparatively safe, but this most favorable condition was of short duration.

The first plan of improvement was to construct two parallel high-tide jetties, 800 feet apart, running out to sea a sufficient distance to scour and maintain a channel with a least depth of 8 feet over the bar at low water, the north jetty to start from Rackcliffe Rock and the south jetty from a point inside the entrance. In 1891 the project was changed to provide for an entrance width of 600 feet instead of 800 feet. The estimate of cost, as revised in 1892, was $285,000.

Up to June 30, 1896, the sum of $141,162.69 had been expended on this improvement and $6,883.90 for snagging on the upper river, making the total expenditure $148,046.59.

The result was to secure a comparatively stable channel across the bar. This channel had at times a depth of from 8 to 10 feet, but was subject to very considerable shoaling from the effect of winds and tides, having sometimes as little as 4 or 5 feet.

On June 30, 1896, the north jetty was 510 feet long and the south jetty 2,116½ feet long. The result was to secure a straight channel across the bar varying from 4 to 10 feet depth.

The traffic on this river for the calendar year 1896 is reported as 21,106 tons. The receipts consist principally of general merchandise, machinery, and building material; the shipments, of lumber, coal, and agricultural products.

July 1, 1896, balance unexpended		$21,953.41
June 30, 1897, amount expended during fiscal year		952.57
July 1, 1897, balance unexpended		21,000.84
July 1, 1897, outstanding liabilities	$3,017.31	
July 1, 1897, amount covered by uncompleted contracts	7,784.69	
		10,802.00
July 1, 1897, balance available		10,198.84
Amount (estimated) required for completion of existing project		115,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		115,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix R R 2.)

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3. Coquille River, Oregon, between Coquille City and Myrtle Point.—The Coquille is a tidal river navigable by small coasting vessels from its mouth to Coquille City, 25 miles, and thence by river craft to Myrtle Point, a further distance of 13 miles. Navigation in this upper stretch had always been much obstructed by shoals and snags, the latter being brought in at each freshet by the various forks, which drain densely timbered basins.

The plan of improvement, adopted in 1891, is to remove all objectionable snags and to contract the river at certain shoals to a width of 50 feet. The cost was estimated in 1891 at $26,000, exclusive of expenditures previously made ($6,883.90). A revised estimate, made in 1894, places this cost at $50,980.77, of which $22,000 has been appropriated.

The amount expended under the project of 1891 to June 30, 1896, was $8,437.04. The work done was of a temporary character, being principally confined to the removal of snags, etc. As the shoaling from new obstructions was continuous, no general increase of navigable capacity was secured.

During the last year work has been confined to some snagging done below Rackcliffe Landing, since June 18, 1897.

The traffic between Coquille City and Myrtle Point for the calendar year 1896 is reported as 3,105 tons, or about the same as that for the preceding year. The up traffic consists of general merchandise and machinery, and the down traffic of agricultural products.

July 1, 1896, balance unexpended		$13,562.96
June 30, 1897, amount expended during fiscal year		122.60
July 1, 1897, balance unexpended		13,440.36
July 1, 1897, outstanding liabilities	$357.50	
July 1, 1897, amount covered by uncompleted contracts	12,252.50	
		12,610.00
July 1, 1897, balance available		830.36
Amount (estimated) required for completion of existing project		28,980.77
Amount that can be profitably expended in fiscal year ending June 30, 1899		28,980.77
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix R R 3.)

4. Entrance to Coos Bay and Harbor, Oregon.—The entrance to Coos Bay was originally obstructed both by the outer bar of shifting sand and by the inner shoals, caused by sands driven in during the prevalence of northwesterly winds. The north spit was advancing under the influence of these winds and contracting the navigable channel near the southern headland to a very narrow width, and causing the channel across the bar to follow in a tortuous course along the west side of the spit. The low-water depth on the bar was sometimes as little as 10 feet. The channel had at times broken through the north spit nearly on the range from Fossil Point to Coos Head, making a nearly straight line of entrance. At such times the greatest depth was found, and vessels could enter or leave the port without difficulty. The mean rise of tide above the plane of reference was 5.6 feet.

It was proposed in 1879 to build a jetty, starting 250 yards below Fossil Point and extending in the direction of Coos Head, to prevent further encroachment on the channel by the north spit and to permanently open a direct channel across the bar. The cost of this project, since abandoned, was estimated at $600,000.

The present project, adopted in 1889 (Board of Engineers, October 27,

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1889), is to construct two high-tide jetties of stone extending seaward, with an entrance width of 1,500 feet, the north jetty to start from the southern end of the north spit and the south jetty to start from Coos Head. The reclamation of the sands of the north spit to prevent their being blown into the channel is also included in the project.

The amount expended to June 30, 1896, was $213,750 on the old project and $429,409.42 on the new, a total of $643,159.42.

The north jetty had been built to its contemplated length of 10,368 feet. For 5,000 feet from the shore end the enrockment had been raised to high-tide level, and for the remaining distance to about the level of low water.

Placing of rock on the jetty at an average rate of 14,000 tons per month has been in progress since December, 1896. There has been a least low-water depth on the bar of 18 to 22 feet. The channel has shifted a little to the southward, away from the jetty. The average tide is 5½ feet.

The aggregate receipts and shipments from Coos Bay during the calendar year 1896 are reported as 144,934 tons. The receipts consisted principally of articles of general merchandise; the shipments, coal, lumber, and agricultural products. The aggregate reported for calendar year 1895 was 128,544 tons.

July 1, 1896, balance unexpended		$95,590.58
June 30, 1897, amount expended during fiscal year		35,866.95
July 1, 1897, balance unexpended		59,723.63
July 1, 1897, outstanding liabilities	$7,365.09	
July 1, 1897, amount covered by uncompleted contracts	43,784.51	
		51,149.60
July 1, 1897, balance available		8,574.03
Amount (estimated) required for completion of existing project		1,941,412.20
Amount that can be profitably expended in fiscal year ending June 30, 1899		600,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix R R 4.)

5. Harbor at Coos Bay, Oregon (dredging).—A number of shoals interfere with navigation in the upper part of Coos Bay and the adjacent sloughs, the principal shoal being just below Marshfield, at the upper end of the bay.

The project for improvement contemplates the construction of a dredge and two scows and the opening of channels 10 feet deep at low water through the obstructing shoals, the estimated cost being $27,390. Since the preparation of this project in 1891 a greater depth than was anticipated has been secured at the harbor entrance, and the proposed depth of 10 feet on the shoals is now inadequate for the accommodation of vessels which frequent the harbor.

As the appropriations of 1894 and 1896 (aggregating $27,390) were insufficient to construct and operate the proposed dredging plant, operations have been delayed awaiting action on a joint resolution now before Congress allowing the War Department the option of contracting for the necessary dredging.

The amount expended to June 30, 1896, was $500.

July 1, 1896, balance unexpended	$26,890.00
June 30, 1897, amount expended during fiscal year	15.08
July 1, 1897, balance unexpended	26,874.92

(See Appendix R R 5.)

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6. Coos River, Oregon.—The river and harbor act of June 3, 1896, contains an appropriation of $5,000 for improving Coos River, Oregon, in accordance with plans submitted January 19, 1895.

The plans to which reference is made provide for removing snags and bowlders and cutting through bars where necessary to secure a channel 50 feet wide from the mouth of the river to the head of navigation on the north and south forks, including 5½ miles on the main river and about 8½ miles on each fork. The average range of tide is about 5 feet for the entire distance, giving ample depth for navigation. Estimated cost, $5,000.

There were no expenditures during the fiscal year ending June 30, 1896.

Work during the year has been confined to a little snagging and the deposit of some quarry débris to form a training dike.

July 1, 1896, balance unexpended	$5,000.00
June 30, 1897, amount expended during fiscal year	130.00
July 1, 1897, balance unexpended	4,870.00
July 1, 1897, outstanding liabilities	60.00
July 1, 1897, balance available	4,810.00

(See Appendix R R 6.)

7. Umpqua River, Oregon.—Just below Scottsburg, the head of navigation, the Umpqua River is obstructed by five sandstone bars or ledges, separated by pools of about 150 feet. These bars, which have a width of from 12 to 15 feet, are submerged but from 1 to 2 feet at low stages of tide and river.

The project adopted in 1885 and extended in 1890 contemplates securing a channel from Scottsburg to the mouth of the river (26 miles) having a minimum width of 50 feet and a low-water depth of 4 feet. Total cost, as estimated in 1890, $15,685.89.

The amount expended under the present project to June 30, 1896, was $15,685.89, and under previous projects $17,814.11, making the total expenditure $33,500.

With this expenditure the improvement had been completed, except near Scottsburg, where the removal of about 500 cubic yards of rock obstructions is still required.

No work was done during the last fiscal year.

The receipts and shipments for the calendar year 1896 are reported as 17,953 tons, or about 4,000 tons less than the preceding year. Receipts consist principally of general merchandise and shipments of lumber, grain, and fish.

July 1, 1896, balance unexpended	$6,000.00
June 30, 1897, amount expended during fiscal year	29.98
July 1, 1897, balance unexpended	5,970.02
July 1, 1897, outstanding liabilities	4,000.00
July 1, 1897, balance available	1,970.02

(See Appendix R R 7.)

8. Mouth of Siuslaw River, Oregon.—The Siuslaw River enters the sea through a shifting sand beach without headland or other fixed point to mark the entrance. The channel across this outer bar has a range of about 1 mile in location and varies in depth from 5 to 12 feet at low water, the latter being equal to the controlling depth inside.

The project, adopted in 1891 and modified in 1892, contemplates the construction of two high-tide jetties of stone to direct the currents

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upon the outer bar in a direction nearly perpendicular to the coast, the north and south jetties to be 4,500 feet and 3,200 feet long, respectively, and to converge to give an entrance width of 600 feet on the crest of the bar. Estimated cost, $700,000.

The amount expended to June 30, 1896, was $94,179.30.

The work done to the above date included the construction and assemblage of the necessary plant, the construction of a receiving wharf, of a railway trestle along the beach from the wharf to the inner end of the north jetty, a distance of 2,500 feet, and of the requisite buildings.

The trestle and tramway were repaired and the north jetty extended, but not completed, for a length of 500 feet.

The progress thus far made has been insufficient to materially affect the channel depth on the bar.

The amount of traffic entering and leaving this river during the calendar year 1896 is reported to be 7,184 tons, an increase of 2,000 tons over the preceding fiscal year.

July 1, 1896, balance unexpended		$27,820.70
June 30, 1897, amount expended during fiscal year		1,148.07
July 1, 1897, balance unexpended		26,672.63
July 1, 1897, outstanding liabilities	$1,011.99	
July 1, 1897, amount covered by uncompleted contracts	11,224.34	
		12,236.33
July 1, 1897, balance available		14,436.30
Amount (estimated) required for completion of existing project		578,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix R R 8.)

9. Alsea River, Oregon.—The river and harbor act of June 3, 1896, contains an appropriation of $3,000 for improving Alsea River, Oregon, in accordance with plans submitted January 19, 1895.

The plans to which reference is made propose the improvement of the downstream navigation of the river at the higher stages from the forks to the head of tide by the removal of rocks and other obstructions. The length of river to be thus improved is 31 miles. Estimated cost, $3,000.

Work has just begun on this improvement under contract.

July 1, 1896, balance unexpended		$3,000.00
June 30, 1897, amount expended during fiscal year		29.19
July 1, 1897, balance unexpended		2,970.81
July 1, 1897, outstanding liabilities	$5.60	
July 1, 1897, amount covered by uncompleted contracts	1,475.00	
		1,480.60
July 1, 1897, balance available		1,490.21

(See Appendix R R 9.)

10. Yaquina Bay, Oregon.—Prior to improvement there were three channels across the entrance bar, the south channel being most used, although seriously obstructed by rocks. The middle channel was free from rock obstructions, but was too shoal for general use, while the north channel was so crooked and rocky as to be considered unnavigable. The prevailing depth over the bar was from 7 to 8 feet at low water, with a mean tide of 7.1 feet. Owing to the shifting character of the bar, the channels across it were constantly shifting, both in location and depth.

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The original project, adopted in 1881, was to build a jetty 2,500 feet long on the south side of the entrance, with its top 2 feet above low water, with a view to closing the south channel and increasing the depth in the middle channel to 17 feet at high tide. In 1888 the project was amended to provide for raising the south jetty to the level of high water, with a total length of 3,748 feet, and to construct a mid-tide jetty on the north of the entrance, to be 2,300 feet long and to terminate opposite the outer end of the south jetty, so as to give an entrance width of 1,000 feet. In 1892 the plan was further modified to raise the north jetty to the level of high tide and to construct five groins or spurs on the north side of the south jetty, to prevent undermining. Total cost estimated in 1890 at $755,000.

A Board of Officers of the Corps of Engineers, appointed pursuant to sundry civil act of March 2, 1895, submitted a report, October 11, 1895 (Annual Report of Chief of Engineers for 1896, pp. 3284–3309), proposing a modification of project involving the parallel extension of the north and south jetties for 2,100 and 2,200 feet, respectively, with groins about 100 feet long, at 300-foot intervals on the channel side of the south jetty, and an additional spur 800 feet long to be built from the south jetty near its root. The Board also proposed the removal of two detached rocks outside the entrance. The estimated cost of this extension was $1,025,800.

The amount expended to June 30, 1896, was $683,768.80.

At the above date both jetties had been extended to the full length provided in the project of 1892, and all rock in place except about 15,000 tons on the north jetty. The depth on the bar had been increased from 12 to 15 feet at mean low water, completing the project as to channel depth.

The river and harbor act of June 3, 1896, provides for—

Improving Yaquina Bay, Oregon: Continuing improvement, twenty-five thousand dollars: *Provided*, That contracts may be entered into by the Secretary of War for such materials and work as may be necessary to complete the project as recommended by the Board of Officers of the Engineer Corps October eleventh, eighteen hundred and ninety-five, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate one million dollars, exclusive of amount herein and heretofore appropriated.

Work under the extended project, or the making of a continuing contract for this work, has not yet been approved by the Secretary of War, and no appropriation was made for this work by the sundry civil act of June 4, 1897. Therefore no estimate is presented for this work for the year ending June 30, 1899.

The amount of freight received and shipped from Yaquina Bay in the calendar year 1896 is reported as 17,883 tons, the receipts consisting principally of general merchandise and salt, and the shipments of grain, flour, potatoes, building stone, cooperage, and cordwood. This is a decrease of 7,000 tons from previous calendar year.

July 1, 1896, balance unexpended	$26,231.20
June 30, 1897, amount expended during fiscal year	1,190.16
July 1, 1897, balance unexpended	25,041.04
July 1, 1897, outstanding liabilities	55.00
July 1, 1897, balance available	24,986.04
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	1,000,000.00

(See Appendix R R 10.)

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11. Nestugga River, Oregon.—The river and harbor act of June 3, 1896, contains an appropriation of $6,000 for improving Nestugga River, Oregon, from town of Woods to the ocean, in accordance with plans submitted January 18, 1895.

The plans to which reference is made propose the removal of a rocky reef which forms a dangerous obstruction at the entrance to Nestugga Bay. Estimated cost, $6,000.

A contract for this improvement is now in force.

July 1, 1896, balance unexpended	$6,000.00
June 30, 1897, amount expended during fiscal year	82.78
July 1, 1897, balance unexpended	5,917.22
July 1, 1897, amount covered by uncompleted contracts	3,750.00
July 1, 1897, balance available	2,167.22

(See Appendix R R 11.)

12. Tillamook Bay and Bar, Oregon.—Tillamook Bay, 50 miles south of the Columbia River, has a tidal area of 13.5 miles, with a mean tide of 6.5 feet. The entrance channel is one of the safest on the coast, being direct and stable. The greater portion of the bay is uncovered at low tide, presenting a succession of sand and mud flats traversed by four channels of fair depth at the entrance, but shoaling to but 1 or 2 feet at the head of the bay. The only connection between these channels is near the mouth of the bay.

Tillamook City, the chief town on the bay, is situated on Hoquarten Slough, and is reached by the main or Garibaldi Channel. The other points of importance are on the north or Bay City Channel.

The project adopted in 1892, and revised in 1895, is to make a navigable pass from the north to the main channel, and thus provide a direct route by way of these channels from the entrance to all important points on the bay. The project also includes the construction of dikes at various points to concentrate the flow in these channels. Estimated cost, $100,000.

The amount expended under the present project from 1892 to June 30, 1896, was $29,363.63.

At the above date dikes had been built at Junction Bar in the main channel, at Dry Stocking Bar in Hoquarten Slough, across the head of the middle channel, across the south pass of Wilson River, and at the mouth of Kilchis River. The Junction Bar dike had increased the depth somewhat on that bar, but there were no perceptible results on Dry Stocking Bar.

Work during the past year consisted in repairing existing dikes, constructing dikes across the channel to the south of Junction Island Flat, in the main channel below Junction Island Flat, across the head of the south fork of Trask River, and one across the north fork below Stillwell Ditch; laying flat protection between Junction Island Flat and the Middle Channel dike, excavating a channel between the north and main channels, and enlarging Stillwell Ditch.

The amount of traffic entering and leaving this bay during the calendar year 1896 is reported as aggregating 25,977 tons, the receipts consisting principally of general merchandise, agricultural implements and flour, and the shipments of lumber, fish, and agricultural products. For the preceding fiscal year the aggregate of receipts and shipments was reported as 25,216 tons.

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July 1, 1896, balance unexpended	$18,636.37
June 30, 1897, amount expended during fiscal year	17,158.23
July 1, 1897, balance unexpended	1,478.14
July 1, 1897, outstanding liabilities	23.95
July 1, 1897, balance available	1,454.19

Amount (estimated) required for completion of existing project	52,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	52,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix R R 12.)

13. Mouth of Columbia River, Oregon and Washington.—Prior to commencing the work of construction in 1885 there were from one to three channels across the bar at the mouth of Columbia River, and these channels varied both in location and in depth, the latter being usually from 19 to 21 feet, while the location shifted through nearly 180° from Cape Disappointment to Point Adams.

The project for improvement adopted in 1884 contemplated securing a low-water channel depth of 30 feet across the bar at the mouth of the river by the construction of a jetty to extend from the shore near Fort Stevens across Clatsop Spit in the direction of a point about 3 miles south of Cape Disappointment, the jetty to be built of rubble and random blocks of stone of large size resting upon mattresses of brush. Estimated cost, $3,710,000.

The amount expended to June 30, 1896, was $1,958,602.09, exclusive of the sum of $50,000 authorized by the river and harbor act of June 3, 1896, to be applied below Tongue Point.

At the above date the jetty had been extended to its proposed length of 4¼ miles, and, together with its four groins, has been completed.

The channel at this date was 29 feet at mean low water and three-fourths mile wide across the bar, with a narrow 30-foot channel.

During the past year no work was done except a survey made in June, 1897. This survey reveals a 30-foot channel 2,000 feet wide across the bar in nearly the same position as last year.

As this improvement is supplemental to that of the Columbia and Lower Willamette rivers, commercial statistics have been furnished by the officer in charge with his report on the latter improvement.

July 1, 1896, balance unexpended	$17,077.91
June 30, 1897, amount expended during fiscal year	2,657.90
July 1, 1897, balance unexpended	14,420.01
July 1, 1897, outstanding liabilities	445.83
July 1, 1897, balance available	13,974.18

(See Appendix R R 13.)

14. Columbia River, Oregon, below Tongue Point.—The river and harbor act of June, 1896, makes appropriation for this improvement as follows:

Improving Columbia River below Tongue Point, by way of the South Channel in front of Astoria, Oregon, in accordance with project submitted in the Annual Report of the Chief of Engineers for eighteen hundred and ninety-five. Fifty thousand dollars of the balance on hand to the credit of the mouth of the Columbia River improvement is hereby authorized to be expended on this work, in the discretion of the Secretary of War.

The project referred to in this contemplates the removal of the wreck of the *Sylvia de Grasse* and the outer portion of the ledge upon which it rests, this work to be supplemented by dredging to open a waterway in front of Astoria 25 feet deep and 250 feet wide at the bottom, in

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accordance with the general project for improvement of the Columbia and Lower Willamette rivers from Portland to the sea. Estimated cost, $121,550.

There were no expenditures during the fiscal year ending June 30, 1896.

During the past year 103,231 cubic yards of sand has been dredged out of the channel above the Sylvia de Grasse reef, thereby materially improving it.

July 1, 1896, balance unexpended	$50,000.00
June 30, 1897, amount expended during fiscal year	2,781.66
July 1, 1897, balance unexpended	47,218.34
July 1, 1897, outstanding liabilities	1,178.40
July 1, 1897, balance available	46,039.94

Amount (estimated) required for completion of existing project	71,550.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	71,550.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix R R 14.)

15. Columbia and Lower Willamette rivers below Portland, Oreg.—The project adopted in 1877 for improving the channel of these rivers from Portland to the sea, covering 12 miles in the Willamette and 98 miles on the Columbia River, contemplated increasing the depth in the shoalest places, where there were but 10 to 15 feet at low water, to secure a minimum depth of 20 feet at this stage. In 1891 this project was extended to provide for a low-water channel depth of 25 feet. (Board of Engineers, October 14.)

The total amount expended to June 30, 1896, was $1,076,195.32, of which $221,780.46 was expended prior to the adoption of the project of 1877.

As a result of the works of contraction, of bank revetment, and of dredging, deep-draft vessels were for the first time able to pass fully loaded from Portland to the sea in September, 1893. At the close of the fiscal year 1896, by taking advantage of the tide, a draft of 23 feet or more could be carried.

During the fiscal year 1897 operations were confined to dredging to maintain the depth previously secured and to the removal of obstructions from the channel, the funds available being insufficient for obtaining any material increase of the general depth. Total excavation made, 366,788 cubic yards.

Dredging was also carried on during the year by the port of Portland, the sum of $6,984.33 having been expended under its direction for dredging shoals in the Lower Willamette and Columbia rivers. Total dredging made, 90,200 cubic yards.

The traffic on these rivers for the calendar year 1896 aggregated 1,507,784 tons, a very slight increase on the aggregate of the previous year.

July 1, 1896, balance unexpended	$104,169.68
June 30, 1897, amount expended during fiscal year	27,128.97
July 1, 1897, balance unexpended	77,040.71
July 1, 1897, outstanding liabilities	59.85
July 1, 1897, balance available	76,980.86

Amount (estimated) required for completion of existing project	472,464.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	300,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix R R 15.)

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16. Columbia River between Vancouver, Wash., and the mouth of Willamette River.—The principal obstruction in this portion of the river consists of a shoal on the north side of Hayden Island, opposite the city of Vancouver, upon which the low-water depth is but 9 feet.

The project for improvement adopted in 1892 provides for a dam to be built to the height of 4 feet above low water from the Oregon shore to the head of Hayden Island to concentrate the flow in the main channel and remove the bar by increased scour. Estimated cost, $33,000.

The amount expended to June 30, 1896, was $32,994.80.

The dam was built under contract, but the contractors having failed to close a gap of about 60 feet near the island end, the contract was annulled in February, 1894, at which time the gap had been greatly widened by scour; an attempt was then made, under a new contract, to secure the work against further injury; it was unable, however, to withstand the succeeding flood, and further operations were abandoned through lack of funds. No increase of navigable depth was secured.

In November, 1895, a project was submitted for completing the improvement at an estimated cost of $67,000, and this sum was appropriated by the river and harbor act of June 3, 1896. With this sum it is proposed to extend the dam 1,500 feet, with a downstream deflection north of Hayden Island, the effect of the dam to be supplemented by dredging in the main channel. This project was submitted to Congress in compliance with Senate resolution of December 24, 1895, and is printed in Senate Doc. No. 54, Fifty-fourth Congress, first session, and in Annual Report, Chief of Engineers, 1896, pages 3264–3265.

No work was done during the past year, the river having remained at too high a stage.

The aggregate of traffic on this portion of the Columbia River for 1895 is reported as 45,595 tons.

July 1, 1896, balance unexpended	$67,005.20
July 1, 1897, balance unexpended	67,005.20

(See Appendix R R 16.)

17. Canal at the Cascades, Columbia River, Oregon.—The Cascades of the Columbia River are located at the head of a narrow gorge some 4½ miles in length, through which the river crosses the Cascade Mountain Range. In the first 2,500 feet of this gorge, known as the Cascades, there is a fall of 24 feet at low water, and below this are rapids which extend throughout its length.

The project for improvement, as revised in 1886, includes the construction of a canal for the passage of the Cascades, with locks to overcome the low-water fall of 24 feet, and to provide for navigation up to a stage of 20 feet above low water at the foot of the canal.

The modified project, for which appropriation was made by the river and harbor act of June 3, 1896, includes the making of a second lock by putting in side walls and concrete flooring between the upper lock gate and the upper guard gate to extend the use of the canal up to a stage of 42 feet above low water at its foot, and for raising the protection works to provide against damage in case of the future occurrence of a flood of the height attained in 1894. The cost of these modifications was estimated by the Board of Engineers at $413,360.

The amount expended to June 30, 1896, was $3,303,550.81. Up to that time the masonry of the canal and lock, as originally designed, was practically completed, including the flooring of the upper and lower bays with concrete; the four pairs of lock gates, the main culvert valves, and the hydraulic machinery for operating them were in position and had been tried, also the pipe line for bringing water under pressure

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for operating. The excavation had been completed except for 100 feet at the upper and 150 feet at the lower entrance.

The concrete flooring between the upper lock and upper guard gates, under the modified project, had also been completed.

During the fiscal year 1897 the work under the continuing contract (the original project as revised in 1886) was completed

The act of June 3, 1896, appropriating $50,000 for work under the project as revised and extended by the Board of 1894, required an earlier opening of the work to navigation than was contemplated by the Board. In order to comply safely with this requirement, it was necessary to modify somewhat the plans for the walls between the upper lock and upper guard gates and to build only parts of them. The north wall was completed to a height of 34 feet (ref. 122.0), while the part of the concrete portion of the south wall in rear of the filling culvert was put in to prevent washing of the bank on that side. This work was done between September 15, 1896, and October 23, 1896, and the locks were thrown open to navigation on November 5, 1896. From that date to June 30, 1897, inclusive, a period of seven months and twenty-six days, there have passed through the locks 302 steamboats of an aggregate registered tonnage of 81,985.68 tons, carrying 4,941.15 tons of freight and 9,081 passengers.

The average amount of freight transported by the State Portage Railway from the Lower to the Middle Columbia River during the four years ending June 30, 1896, was 8,096 tons. Average number of passengers, 7,489.

July 1, 1896, balance unexpended	$369,449.19
June 30, 1897, amount expended during fiscal year	165,603.90
July 1, 1897, balance unexpended	203,845.29
July 1, 1897, outstanding liabilities	163,661.64
July 1, 1897, balance available	40,183.65
Amount (estimated) required for completion of existing project	334,260.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	334,260.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix R R 17.)

18. Operating and care of canal and locks at the Cascades of the Columbia River, Oregon.—The canal and locks at the Cascades of the Columbia River were formally opened to navigation November 5, 1896, and have been operated since.

Allotment of $2,850 was made for this work from the general appropriation of July 5, 1884, for operating and care of canals and other works of navigation.

About the end of December both of the lower culvert valves began to give trouble, and a diver discovered that the trunnion of the bearings had moved out of place, the one on the north side could only be partly opened, and the one on the south side had become unmovable and very much damaged. The north valve was fixed, and the canal is being operated with this north culvert only. The south valve will be examined when the water reaches a low stage, and an estimate made for its repair.

The total expenditure on operating and care of this work during the year was $2,434.72.

(See Appendix R R 18.)

19. Columbia River at Three Mile Rapids, and the construction and equipment of a boat railway from the foot of The Dalles Rapids to the head of Celilo Falls, Oregon and Washington.—Pursuant to the river

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and harbor act of August 18, 1894, which appropriated $100,000 for this improvement, the line of the proposed boat railway has been definitely located. It begins at Big Eddy and terminates above Celilo Falls, and has a total length of 9 miles. The line as located is considered most favorable, having but four curves, each of one-half degree, and a maximum grade of but 13.2 feet per mile. The low-water lifts at the upper and lower terminals are 62 feet and 77 feet, respectively. The cost of the improvement was estimated in 1893 at $2,264,467.

For the right of way and for the terminal and other facilities of the boat railway a total area of 297.08 acres is required, and an additional area of 26.75 acres is needed for changes in the track of the Oregon Railroad and Navigation Company to accommodate the line of the boat railway, making a total of 323.83 acres to be acquired.

All the land required in connection with this work has not yet been acquired, nor have arrangements yet been made for removal of the track of the Oregon Railway and Navigation Company, nor have detailed plans yet been approved. Under these conditions it is believed the available balance now on hand will be sufficient to meet all obligations which may be incurred during the year ending June 30, 1899. No further estimate is presented.

The amount expended to June 30, 1896, was $6,063.47.

July 1, 1896, balance unexpended	$243,936.53
June 30, 1897, amount expended during fiscal year	5,118.93
July 1, 1897, balance unexpended	238,817.60
July 1, 1897, outstanding liabilities	931.40
July 1, 1897, balance available	237,886.20
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	2,114,467.00

(See Appendix R R 19.)

20. Willamette River above Portland and Yamhill River, Oregon.—At the time of the adoption of the present project, in 1878, the mouth of the Yamhill River, 40 miles above Portland, was the head of low-water navigation, with a draft of 2½ feet. Above this point the controlling depth was but 1 foot.

The project of 1878 contemplates the improvement of the river by the removal of obstructions and the construction of dikes to contract the waterway at shoal places so as to secure a navigable channel for light-draft boats from Portland to Eugene, a distance of 172 miles. This project was extended in 1892 to include the removal of obstructions in the Yamhill River from its mouth to McMinnville, and by the river and harbor acts of 1892 and 1894 allotments of $3,000 and $2,000, respectively, were made for this purpose from the appropriations for improving Willamette River above Portland. An allotment of $8,000 was also made by the act of 1894 for improving the Willamette River at Corvallis.

The amount expended on this improvement to June 30, 1896, was $247,747.51, the distribution being as follows: $71,373.75 on the general improvement of Willamette under former projects, and $165,780.29 under the project of 1878, $7,382.17 on the improvement of Willamette River at Corvallis, and $3,211.30 in removing obstructions from the Yamhill River under the project of 1892.

The above expenditures were chiefly incurred in removing obstructions as required by the immediate necessities of commerce, and with the exception of the bank revetment at Corvallis little progress was made toward the radical improvement of the river.

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During the fiscal year 1896 operations were continued to completing the revetment at Corvallis and to the removal of obstructions from the Willamette and Yamhill rivers to provide for continued navigation.

The river and harbor act of June 3, 1896, provides for—

Improving Willamette and Yamhill rivers, Oregon, forty thousand dollars, to be expended in accordance with report submitted February twenty-first, eighteen hundred and ninety-six, for Willamette River from Portland to Eugene, and in accordance with report of survey, dated March sixth, eighteen hundred and ninety-five, for lock and dam on Yamhill River: *Provided*, That contracts may be entered into by the Secretary of War for such materials and work as may be necessary to complete said improvements, or said materials may be purchased and work may be done otherwise than by contract, to be paid for as appropriations may from time to time be made by law not exceeding in the aggregate two hundred thousand dollars, including the amount herein appropriated: *And provided further*, That the sum of ten thousand dollars, or so much thereof as may be necessary, shall be available for the purchase or construction of a snag boat with suitable appliances: *Provided further*, That the Secretary of War may, in his discretion, use so much of the money herein appropriated as may be necessary to prevent the erosion of the west bank of the Willamette River opposite Salem, Oregon, and to maintain the river channel at that point.

Under this act a snag boat was built and put in commission November 9, 1896, sixty-six days from date of approval of contract, and has done most efficient service since.

As the high water of this year receded, dike work was begun, and considerable dredging or scraping has been done on various bars.

Plans for the lock and dam on the Yamhill River have been nearly completed.

The statistics for 1896 show, on the Willamette River, a considerable increase of traffic over the preceding years, 1895 and 1894, the aggregate reported for these three years being, respectively:

	Tons.
1896	218,480
1895	134,456
1894	78,138

July 1, 1896, balance unexpended	$40,752.49
Amount appropriated by sundry civil act approved June 4, 1897	160,000.00
	200,752.49
June 30, 1897, amount expended during fiscal year	18,206.23
July 1, 1897, balance unexpended	182,546.26
July 1, 1897, outstanding liabilities	735.62
July 1, 1897, balance available	181,810.64

(See Appendix R R 20.)

21. Gauging waters of Columbia River, Oregon and Washington.—The object of this gauging is to obtain data for use in connection with the improvement of the river and to supply information to persons interested in its navigation.

The amount expended on this work to June 30, 1896, was $5,756. During the last year but one gauge, that at Astoria, has been in operation.

July 1, 1896, balance unexpended	$1,244.00
June 30, 1897, amount expended during fiscal year	445.65
July 1, 1897, balance unexpended	798.35
July 1, 1897, outstanding liabilities	48.00
July 1, 1897, balance available	750.35

Amount (estimated) required for completion of existing project	1,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	1,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix R R 21.)

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IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN WASHINGTON, IDAHO, AND MONTANA.

This district was in the charge of Capt. Harry Taylor, Corps of Engineers, having under his immediate orders Lieut. Meriwether L. Walker, Corps of Engineers, since January 15, 1897. Division Engineer, Col. Charles R. Suter, Corps of Engineers.

1. Willapa River and Harbor, Washington.—Willapa Harbor, formerly known as Shoalwater Bay, connects with the Pacific Ocean 28 miles to the north of the entrance to the Columbia River. The only portion of the harbor to which any consideration in the way of improvement has been given is that in the vicinity of South Bend, the principal city of the harbor, and the terminus of the railroad from the main line of the Northern Pacific at Chehalis.

South Bend is situated very near the mouth of the Willapa River. Just at the upper limits of the town the river divides itself into a main channel and a secondary channel, the latter known as Mailboat Slough. This division of the waters caused bars to form in the main channel at both the upper and lower ends of the slough. There were also several bars in the river proper between South Bend and Willapa City.

The plan of improvement adopted consists in building a dike of piles, brush, and stone across the head of Mailboat Slough, in order to concentrate the ebbing and flooding currents into the main channel, and thereby produce as great a scour as possible on the shoals at the head and foot of the slough; also to dredge a channel 100 feet wide and 8 feet deep at low water through the reef just below Willapa City, and to close Louderback Slough with a pile, brush, and stone dike with the object of compelling the currents to scour a channel through the bar in the river at its lower end. The estimated cost of the work is $31,350.

The project of August 29, 1894, approved by the Chief of Engineers, also provides for cutting a channel through the log jam of North River, a tributary of Willapa Harbor.

The language of the act of August 18, 1894, in making the appropriation for this work, is as follows:

> Improving Willapa River and Harbor, Washington: For completion, thirteen thousand three hundred and fifty dollars: *Provided*, That in the discretion of the Secretary of War two thousand five hundred dollars of the amount hereby appropriated for said river and harbor may be used in removing obstructions in North River.

In accordance with the above quoted act the project of August 29, 1894, also provides for cutting a channel through the log jam of North River, a tributary of Willapa Harbor.

The amount expended to June 30, 1896, was $26,378.39, of which $23,878.39 had been spent on Willapa River and Harbor proper, and $2,500 on the improvement of the North River.

Up to June 30, 1896, the dike work in the river and harbor, the work of dredging through the shoal just below Willapa City, and the contemplated work on the jam in the North River had been completed.

The amount expended during the fiscal year ending June 30, 1897, was $1,394.41, which was all expended on Willapa River and Harbor proper.

The work called for by the project has all been completed. The object of the improvement, so far as to give a channel 8 feet deep at mean lower low water to Willapa City, has been practically accomplished.

The dikes at Mailboat Slough have caused a general deepening of

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the shoals in their vicinity of about 2 feet, so that the least depth to South Bend, the principal city on Willapa Harbor, is now 15 feet at mean lower low water.

A channel 50 feet in width has been cut through the jam on the North River.

The dikes already built will probably need some slight repairs, but the money already appropriated is sufficient to fully complete the project and leave a small unexpended balance. It is recommended that the balance of the appropriation, or so much thereof as may be necessary after completing the project, be made available for more thoroughly clearing a channel through the North River jam.

COMMERCIAL STATISTICS.

Table of comparative statistics.

Year.	Tons.	Value.
1894 *a*	66,908	$639,280
1895 *a*	61,858	705,570
1896 *a*	48,960	600,600
1896 *b*	27,542	351,175

a Fiscal year. *b* Calendar year.

July 1, 1896, balance unexpended	$4,971.61
June 30, 1897, amount expended during fiscal year	1,394.41
July 1, 1897, balance unexpended	3,577.20

(See Appendix S S 1.)

2. Grays Harbor and bar entrance, Washington.—The first appropriation for this work was made in the river and harbor act of June 3, 1896.

The entrance to Grays Harbor from the Pacific Ocean lies in latitude 46° 55′ north, being 45 miles north of the mouth of the Columbia River.

The harbor has a length from east to west of 17 miles, and from north to south a maximum breadth of 14 miles. There are a number of rivers tributary to the harbor, the principal ones being the Chehalis, Satsop, Wynooche, Wishkah, Hoquiam, and Humptulips, all of which come from the east and north. There are two main channels crossing the harbor from east to west—the north and south channels, of which the north channel is the principal one, and has been improved.

A large part of the harbor is occupied with tide flats, bare at low water. The total tidal area of the harbor is estimated at 96.8 square miles. At low tide the area covered by water is estimated at 30.6 square miles, or less than one-third of the total area. The average range of the tide is 8.4 feet, with a maximum range of 12.9 feet.

The harbor throat lies between two low sandy peninsulas, which are about 12,500 feet apart, measured between high-tide lines.

Through the harbor throat there is a channel having a maximum depth of 100 feet or more. A single broad waterway extends for more than 2 miles out to sea from the harbor throat, with depths gradually diminishing to 30 feet. Between this deep waterway and the open sea lies a bar convex to the sea and connected with the sand spits on the two sides of the harbor throat.

Across the bar there is no well-defined, decided, permanent channel, but there are several variable shifting channels having depths of about

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12 or 13 feet. The general average distance between the inner and outer 18-foot curve is one-half mile.

The proposed plan of improvement is to control, by means of a single jetty extending out to sea from the point on the south side of the harbor throat a distance of about 3½ miles, the ebbing and flooding waters to a sufficient extent to concentrate and direct upon the bar a much greater portion thereof than would naturally go there. It is expected that a depth across the bar of 24 feet at mean lower low water will be obtained.

The jetty is to be of rubblestone built above high-tide level. The estimated cost of the work is $1,000,000.

A full description of this work with plan is published in the Annual Report of the Chief of Engineers for 1895, pages 3517–3528.

In accordance with the authority granted by the act making the first appropriation for this work, it is to be done under a "continuing contract."

The expenditures during fiscal year ending June 30, 1897, were the first made for this work and amounted to $1,271.76.

During the fiscal year ending June 30, 1897, specifications for the work to be done were prepared and advertisements issued.

The construction of the jetty will be commenced and carried on as rapidly as possible.

TABLE OF COMPARATIVE STATISTICS.

Exports and imports.

Year.	Tons.	Value.
1893 *a*	298,236	$4,431,743
1894 *a*	302,102	3,221,500
1895 *a*	159,744	848,591
1896 *a*	227,351	1,420,055
1896 *b*	110,748	629,677

a Fiscal year. *b* Calendar year.

July 1, 1896, balance unexpended	$20,000.00
Amount appropriated by sundry civil act approved June 4, 1897	350,000.00
	370,000.00
June 30, 1897, amount expended during fiscal year	1,271.76
July 1, 1897, balance unexpended	368,728.24
July 1, 1897, outstanding liabilities	42.80
July 1, 1897, balance available	368,685.44
Amount (estimated) required for completion of existing project	630,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	450,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix S S 2.)

3. Chehalis River, Washington.—The portion of the Chehalis River that it is possible to navigate is about 90 miles in length, from Claquato to its mouth. This may well be considered in three sections:

1. The tidal section, from the mouth to Montesano, a distance of 15 miles. In this portion there is about 16 feet of water at high tide, and coasting vessels traverse it.

2. From Montesano to Elma, 16 miles, the river is slightly affected by the tides and has in general sufficient depth of water for light-draft

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boats. But navigation is obstructed by logs and fallen trees and in summer by a scarcity of water on the bars.

3. Above Elma the river is a succession of shoals and pools, with only 6 to 12 inches of water on the shoals during low water. This part of the river is practically blockaded with snags.. With improvement this river could be navigated above Elma for perhaps four months in the year a distance of 30 miles, and occasional trips made much farther up.

The plan of improvement contemplates the removal of snags, overhanging trees, jams, drift heaps, shoals, and other obstructions to navigation which may from time to time accumulate in the portion of the river regularly used by boats.

The cost of the work is indefinite.

The amount expended to June 30, 1896, was $13,000, and the river from Montesano to its mouth was kept open and free from troublesome snags.

The amount expended during the fiscal year ending June 30, 1897, was $1,481.99.

During the fiscal year ending June 30, 1897, the snags which had accumulated in the river during the preceding year were removed.

TABLE OF COMPARATIVE STATISTICS.

Exports and imports.

Year.	Tons.	Value.
1895 *a*	4,354	$233,691
1896 *a*	2,841	(*c*)
1896 *b*	2,561	246,498

a Fiscal year. *b* Calendar year. *c* Not given.

July 1, 1896, balance unexpended	$3,000.00
June 30, 1897, amount expended during fiscal year	1,481.99
July 1, 1897, balance unexpended	1,518.01
Amount (estimated) required for completion of existing project	Indefinite.
Amount that can be profitably expended in fiscal year ending June 30, 1899	3,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix S S 3.)

4. Puget Sound and its tributary waters, Washington.—The old title of this appropriation was "improvement of Skagit, Stillaguamish, Nooksack, Snohomish, and Snoqualmie rivers, Washington." Under date of August 4, 1892, the change to the new title was approved and all money and property on hand were transferred and thereafter accounted for under the new title.

In their original conditions the navigable streams flowing into Puget Sound carried water enough for the purpose of steamer navigation, but were obstructed by snags, fallen trees, and log jams. They were the great highways of the country, traveling by land being almost impossible on account of the heavy timber, dense underbrush, and fallen logs.

About their mouths there are in every instance large areas of shallow water with tortuous channels, and these are often obstructed by drift. These shallows act as submerged dams to the rivers and by preventing the free outflow of their waters indirectly do great damage by inundating the lowlands through which they flow.

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The plan of improvement contemplates the removal of snags, logs, trees, and other obstructions to navigation. For this purpose a snag boat with an outfit of tools and appliances has been provided. This boat passes from one river to another, doing service in each as far as the necessities of its commerce require and as the amount of the funds appropriated will admit.

With the funds that have been appropriated this snag boat and outfit have been provided, and a large number of snags, jams, overhanging trees, and other obstructions to navigation removed. These, with the trees that from time to time fall into the rivers, will furnish constant employment for the snag boat for an indefinite period.

The amount expended on the project to June 30, 1896, was $93,646.43. The rivers had been cleared of their worst obstructions, their navigation greatly improved, and the annual season during which navigation was suspended by reason of obstructions considerably shortened.

The amount expended during the fiscal year ending June 30, 1897, was $19,827.44.

During fiscal year ending June 30, 1897, the snag boat was rebuilt and more effective work than ever before accomplished in the removal of snags and obstructions; 2,192 snags, ranging in diameter from 10 inches to 10 feet and having an aggregate length of 49,394 feet, were removed from the various rivers, and 348 trees, which were in danger of falling in and becoming obstructions, were cut down and disposed of. The trees which were cut from the banks ranged in diameter from 6 inches to 5 feet and had an aggregate length of 27,477 feet.

The snagging operations will be continued and such other work done as appears advantageous and funds permit.

Shipping.—Five river and Sound steamboats are engaged in traffic on the Skagit River, with an average tonnage of 211.2 tons and an average depth of 5 feet.

On the Snohomish and Snoqualmie rivers six steamboats are engaged in traffic. During the past year they carried 1,910 passengers and 7,905 tons of freight, consisting of general merchandise and farm produce.

July 1, 1896, balance unexpended	$79,853.57
June 30, 1897, amount expended during fiscal year	19,827.44
July 1, 1897, balance unexpended	60,026.13
July 1, 1897, outstanding liabilities	25.00
July 1, 1897, balance available	60,001.13
Amount (estimated) required for completion of existing project	Indefinite.
Amount that can be profitably expended in fiscal year ending June 30, 1899	25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix S S 4.)

5. Harbor at Olympia, Wash.—Olympia is situated at the head of Budd Inlet. The upper end of this inlet is badly shoaled. The shoals extend from the heart of the city, at Fourth Street Bridge, for a distance of 8,750 feet, to a depth of 12 feet at low water in Budd Inlet. These shoals necessitated the building of long wharves out to deep water, the maintenance of which, due to the ravages of the teredo, was very expensive. The alternative of this, i. e., boats coming and going only at high tide, caused great inconvenience.

It is proposed by the plan of improvement adopted to dredge a channel 250 feet wide and 12 feet deep at the mean of the lower low waters from the vicinity of the Fourth Street Bridge to deep water in Budd

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Inlet. Near its inner end the channel is to be widened out to 500 feet, so as to provide a turning basin for boats using it.

The estimated cost of the work was $275,000.

The amount expended to June 30, 1896, was $74,908.45.

A channel 200 feet wide and 6 feet deep at extreme low water had been dredged for the entire distance, from deep water in Budd Inlet to the southern limits of the main waterway at the south line of Second street extended. At this southern limit the dredged waterway had been enlarged into a basin 800 feet long, with an average width of 450 feet and an extreme width of 500 feet, for the convenience of boats in turning.

The Capitol Waterway, which is an extension of the main waterway, to the south of the basin, had also been excavated to a depth of 6 feet at low water for a width of 90 feet from the Fourth Street Bridge to the southern limits of the main waterway.

The amount expended during the year ending June 30, 1897, was $29,017.43.

During the fiscal year ending June 30, 1897, the turning basin and channel were enlarged to the full size proposed by the project, the basin deepened to 10 feet at extreme low water throughout, and the outer end of the channel for a distance of 1,500 feet deepened to 8 feet at extreme low water.

The turning basin was also slightly enlarged by dredging a triangular piece near its inner end on the side next to the main part of the city, along one of the principal docks, where it was for the manifest public interest to do so.

Future work will depend upon the funds appropriated.

TABLE OF COMPARATIVE STATISTICS.

Exports and imports.

Year.	Tons.	Value.
1893 *a*	95,011	$2,087,825
1894 *a*	55,148	421,225
1895 *a*	25,125	239,400
1896 *a*	28,480	266,700
1896 *b*	36,099	191,300

a Fiscal year. *b* Calendar year.

July 1, 1896, balance unexpended	$32,091.55
June 30, 1897, amount expended during fiscal year	29,017.43
July 1, 1897, balance unexpended	3,074.12
Amount (estimated) required for completion of existing project	168,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix S S 5.)

6. Waterway connecting Puget Sound with lakes Union and Washington.—The river and harbor act of September 19, 1890, contained an item directing the appointment of a Board of three officers of the Corps of Engineers upon whom should devolve the duty of selecting and surveying the most feasible location and of estimating the expense of constructing a ship canal to connect the waters of lakes Union, Washington, and Sammamish with Puget Sound, and appropriating $10,000 for the necessary expenses.

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The Board thus appointed consisted of Col. G. H. Mendell, Maj. T. H. Handbury, and Capt. (now Maj.) T. W. Symons. Their report is contained in House Ex. Doc. No. 40, Fifty-second Congress, first session, and also in Annual Report of Chief of Engineers for 1892, page 2762 et seq.

The first appropriation for this work was made in the river and habor act of August 18, 1894.

The above-mentioned report contained a full description of the physical conditions attendant upon the project for uniting the lakes mentioned with Puget Sound, and of the plan proposed for accomplishing the same.

Briefly stated, they are as follows:

Lake Washington lies directly east of Seattle with its longest dimension nearly parallel to Puget Sound, and 2 to 6 miles distant therefrom. It is 19 miles in length, averages about 2 miles in width, and has an area of about 38.9 square miles, or 24,900 acres, of which, probably, 22,000 acres cover a depth of 25 feet or more, with maximum depths of not less than 600 feet. Its outlet is at the south end.

Lake Union lies at the north end of Seattle between Lake Washington and Puget Sound. It has an area of 1½ square miles, or 905 acres, of which 499 acres cover a depth of 25 feet or more, and has a maximum observed depth of 60 feet.

Lakes Washington and Union have no natural connecting waterway, but a small canal has been cut by private enterprise through the divide separating the two lakes at what is known as the Portage.

From Lake Union there is a small stream flowing to the head of Salmon Bay, distant from Lake Union about 1 mile. From the head of Salmon Bay to deep water in Puget Sound there is a distance of about 3 miles.

The average elevation of the surface of Lake Washington is about 7 feet above that of Lake Union, and that of Lake Union is 7.8 feet above the highest high tides in Puget Sound. The variation in the level of Lake Washington amounts to about 2.5 feet either side of the average, and in Lake Union to about 1.5 feet either side of the average. The extreme range of tide is about 18 feet.

The general project for this work contemplates the construction of a ship canal connecting lakes Union and Washington with the waters of Puget Sound through Salmon Bay and Elliott Bay—known as the Smiths Cove route.

The estimated cost of a double-track canal, with masonry locks and including the necessary right of way, is $3,500,000, and of a single-track canal, with composite locks and exclusive of any right of way, $2,316,167.

The amount expended to June 30, 1896, was $5,000, and at that date a cadastral survey of the right of way and overflowed lands had been made for all except the part from Smiths Cove to the head of Salmon Bay.

There was nothing expended during the fiscal year ending June 30, 1897, and no work was done by the United States. The right of way was condemned and damages assessed for part of the route and a survey of the remainder of the route made by the county commissioners of King County.

Detailed plans will be prepared as soon as the money is available, and construction commenced as soon as possible.

There is at present available for expenditure on this work $170,000, but under the provisions of the act of August 18, 1894, no expenditure can be made until the entire right of way and release from all damages

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shall be secured free of cost to the United States. The acquisition of the right of way is in progress, but until completed to the satisfaction of the Secretary of War no detailed plans can be prepared. No estimate for additional funds for the year ending June 30, 1899, is therefore presented.

July 1, 1896, balance unexpended	$170,000.00
July 1, 1897, balance unexpended	170,000.00
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	2,141,167.00

(See Appendix S S 6.)

7. *Everett Harbor, Washington.*—Everett is situated on a peninsula, one side and the end of which are bounded by the Snohomish River and the other side by the waters of Puget Sound. Of the water front on Puget Sound but a small part has deep water; the remainder fronts on the tide flats which have been formed by the Snohomish River.

A portion of the river forming the rear or fresh-water boundary of the peninsula has navigable depths sufficient for all ordinary purposes of commerce, but below this, and especially across the tide flats at the mouth, the water is shallow, and great difficulty is experienced in getting into the fresh-water river harbor back of the city.

The plan of improvement adopted for this work may be generally described as follows:

First, to excavate a harbor basin in the shallows and tide lands adjoining deep water near the river's mouth; second, to dredge a channel from this through the tide flats and the Old River mouth to deep fresh water in the Snohomish River, this channel being designed to bring fresh water to the harbor basin and to afford facilities for navigation about the peninsula and into the deep water bounding the peninsula on the east; and third, to protect and maintain this harbor and channel across the tide flats by a bulkhead interposed between them and the open waters of the sound, the bulkhead to act as a retaining wall for the material dredged from the harbor.

The estimated cost of the improvement is $372,000.

The amount expended on the project to June 30, 1896, was $9,987.99, and at that date a dike for the purpose of retaining the dredged material had been built from the lower end of Smiths Island along the established bulkhead line for a distance of 7,980 feet.

The amount expended on the project during the fiscal year ending June 30, 1897, was $19,220.24.

The retaining dike was extended a distance of 6,456 feet, the part previously built was repaired, and a channel 50 feet wide at the bottom and 6 feet deep at mean low water was dredged from the deep water on the outside in toward the deep water in the river for a distance of 2,885 feet.

The dike will be kept in repair and the dredging continued as funds may be available.

TABLE OF COMPARATIVE STATISTICS.

Exports and imports.

Year.	Tons.	Value.
1895 *a*	79,919	$1,845,282
1896 *a*	144,541	2,724,789
1896 *b*	210,547	15,384,831

a Fiscal year. *b* Calendar year.

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New industries.—Three sawmills and one shingle mill were erected during 1896.

July 1, 1896, balance unexpended	$20,012.01
June 30, 1897, amount expended during fiscal year	19,220.24
July 1, 1897, balance unexpended	791.77
Amount (estimated) required for completion of existing project	342,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	150,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix S S 7.)

8. *Swinomish Slough, Washington.*—Swinomish Slough is a tidal slough connecting the waters of Saratoga Passage and Skagit Bay on the south with Padilla Bay on the north. It is an important water highway, furnishing the most easterly, the shortest, and safest route for the smaller class of steamboats between the northern and southern waters of Puget Sound. It skirts the Skagit Delta, the richest and most extensive agricultural region of western Washington. It is, however, shallow and crooked in some portions, and the approaches to it are across the shallow flats of Padilla Bay on the north and Skagit Bay on the south.

Swinomish Slough is the ordinary meeting place of the tides, although at times the tides run in one direction entirely through.

The ordinary rise and fall of the tides in the slough is about 8 feet. As a general thing throughout the slough there was an abundant depth of water. Opposite La Conner there was 10 to 15 feet at low water; just south of La Conner this increased to 34 feet, while at the northern entrance to the "Hole in the Wall" there was a depth of 40 feet at low water.

Where the slough widens out, especially where the Indians have been in the habit of putting fish traps, this depth decreased, so that there was not over 2 feet at low water in any practicable channel. What channel there was was very crooked.

At the northern end the slough opens out into the flats, forming the southern portion of Padilla Bay, in the midst of diked land and marshes.

At the southern end of the slough there were two passages connecting the slough with the waters of Skagit Bay. These passages were separated by a rocky island called McGlinns Island.

The east passage was wide and shallow, having nowhere more than 2 feet depth at low water. The west passage between McGlinns and Fidalgo islands was at the narrowest place 220 feet wide, with an ample depth of water for all purposes.

This short and crooked passage was so situated with high rocky bluffs on either side that one could not see through from one end to the other. On account of its character it had received and was known by the very descriptive title of the "Hole in the Wall."

This is the passage used almost exclusively by steamers.

The plan of improvement adopted is to dredge a channel 4 feet deep and 100 feet wide from deep water in Saratoga Passage across Skagit Flats, through the shoals of the slough proper, and across the flats of Padilla Bay to deep water, and to build dikes in Skagit and Padilla bays to direct the ebbing and flooding waters through the dredged channels.

The estimated cost of this work is $122,000.

A report of a survey of Swinomish Slough upon which the plan of improvement is based is printed with a general map in House Ex. Doc. No. 31, Fifty-second Congress, first session, and reprinted with-

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out map in the Report of the Chief of Engineers for 1892, pages 2753–2762.

Map showing parts of the improvement is also published in the Report of the Chief of Engineers for 1894, opposite page 2615, and for 1896, opposite page 3377.

The amount expended to June 30, 1896, was $45,924.74.

At that date a wattled pile dike 6,180 feet long had been constructed from a point 400 feet west of the entrance to the "Hole in the Wall" westerly to a point 300 feet distant from the northwest point of Goat Island. A channel 100 feet wide at the bottom and 4 feet deep at mean low water had been dredged parallel to and 75 feet from the dike for a distance of 6,120 feet, and a dike consisting of a single row of piles had been built between Goat and Ika islands, and a channel had been dredged from La Conner north about halfway to the northern end of the slough.

The amount expended during the fiscal year ending June 30, 1897, was $26,905.51.

The wattled dike in Skagit Bay was repaired, a pile, brush, and stone dike connecting McGlinns Island and Gallahers Point built, and a channel dredged across the flat just inside the "Hole in the Wall."

Work in accordance with the project will be extended north of La Conner as fast as available funds permit.

TABLE OF COMPARATIVE STATISTICS.

Exports and imports.

Year.	Tons.	Value.
1893*a*	55,700	$1,510,000
1894*a*	64,050	1,637,000
1895*a*	114,917	1,713,020
1896*a*	131,370	1,709,700
1896*b*	65,375	1,347,664

a Fiscal year. *b* Calendar year.

No new industries have been reported.

July 1, 1896, balance unexpended	$29,075.26
June 30, 1897, amount expended during fiscal year	26,905.51
July 1, 1897, balance unexpended	2,169.75
Amount (estimated) required for completion of existing project	47,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	47,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix S S 8.)

9. Columbia River from Rock Island Rapids to Foster Creek Rapids, Washington.—This portion of the river is 80 miles in length. It flows through a deep canyon with an average fall of 2.2 feet per mile. The river has sufficient water for all purposes of navigation, and the only difficulties in the way of navigation are:

1. The generally swift currents;
2. Rocks here and there which occupy dangerous positions; and
3. The rapids at the Methow, Entiat, and Wenatchee rivers.

The river is navigated from the mouth of the Okanogan, which is practically at Foster Creek Rapids, down to Wenatchee, where connection is made with the Great Northern Railroad.

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A survey with project for improvement of this portion of the river has been made and was the subject of a special report by Capt. T. W. Symons, Corps of Engineers, May 22, 1895, but has not yet been finally adopted.

In the meanwhile a temporary project of improvement was made, based upon a preliminary examination. The project contemplated the removal of obstructive rocks at Rocky Reach and Methow Rapids and at such other places as may be found necessary. Also, to put in "dead men" or other suitable anchorages as points of support for lining up at Entiat and Methow Rapids and to put in a timber boom at Entiat Rapids. This boom was designed to enable boatmen to carry a line to a "dead man" located on an island conveniently situated for boats lining up over the rapids.

The amount expended to June 30, 1896, was $8,005.20, and the results obtained were the removal of a considerable amount of rock at Rocky Reach and at the Methow Rapids, thereby benefiting navigation, and the completion of a boom at Entiat Rapids.

As the funds made available for this improvement were nearly all exhausted prior to June 30, 1896, nothing has been done during the past year. The expenditures during this fiscal year amounted to $2, exhausting the funds.

The river and harbor act of August 18, 1894, contained the following item:

> The Secretary of War may, in his discretion, expend the unexpended balance, eight thousand two hundred and ten dollars and ninety-two cents, of the appropriation heretofore made for the improvement of the Columbia River between the head of Rock Island Rapids and the foot of Priest Rapids, Washington, for the building of a snag boat for use on the Columbia River between Rock Island Rapids and Foster Creek Rapids, and for such other work as may be necessary for the improvement of navigation of said river within the above-named limits.

At the time of the passage of the act this amount had been reduced to $8,005.20.

Commercial statistics.—The transportation during the past fiscal year was as follows: Freight carried, 5,500 tons; number of passengers carried, 1,300.

The freight consisted of general merchandise, grain, and ore.

The amount of freight carried during the previous year was 6,000 tons.

Two stamp mills and a cyanide plant have been erected in the district tributary to this portion of the river during the past year.

The Palmer Mountain Tunnel Company is pushing work on the tunnel through Palmer Mountain, and general mining development has been far greater than in any previous year.

July 1, 1896, balance unexpended	$2.00
June 30, 1897, amount expended during fiscal year	2.00

(See Appendix S S 9.)

10. Upper Columbia and Snake rivers, Oregon and Washington.—Under the above head it has been deemed proper to officially include the continuous Columbia and Snake rivers from Celilo, Oreg., at the head of The Dalles, to Asotin, Wash., situated on the Snake about 7 miles above its junction with the Clearwater.

The upper Columbia and Snake form a continuous line of navigable river, broken by many rapids, which render navigation difficult and dangerous. These rapids are in nearly every instance caused by rocky bars, with occasional bowlders, and the channels are crooked and narrow.

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Before improvement the ruling depth of many of these bars was 2 to 3 feet at low water; some were practically impassable at low water.

The Columbia was navigable all the year round except when closed by ice. The Snake was, however, only navigable during high water, during three or four months in the spring of the year.

Previous to 1877, $120,000 had been appropriated for the work of improvement, and had been expended in surveys and rock removal at the principal rapids.

In 1877, Maj. (now Brig. Gen.) John M. Wilson made a project for the improvement of the upper Columbia and Snake rivers, which consisted in the removal of rock bowlders and rocky reefs and the scraping of gravel bars in the Columbia and Snake as far up as Lewiston. The estimated cost of this work was $132,000.

The present project or plan of improvement consists in the removal of bowlders, gravel bars, and rock ledges, and the construction of such contraction works as may be necessary.

The estimated cost of the work has not yet been accurately determined, because of the lack of full and continuous surveys, and because, from the nature of things, it can not be, as many of the obstructions which it is necessary to remove are continually recurring.

The amount expended on the project to June 30, 1896, was $169,333.03, and the results obtained were the effective removal of the most obstructive rocks and reefs between Riparia and Asotin.

Prior to 1880 much work had been done in removing obstructions to the rapids of the Columbia River between Celilo and the mouth of the Snake, and until 1882 on that part of the Snake below Riparia.

The completion of the Oregon Railway and Navigation Company's line of railroad and a small section of the Northern Pacific, which parallel the Columbia from Celilo to the mouth of the Snake, and cross the Snake at Riparia, has caused the navigation by steamers of these two rivers from Celilo to Riparia to be abandoned.

The further improvement being unnecessary, no work was done on the reaches below Riparia subsequent to the dates above mentioned.

Besides the work of rock removal, dikes were partially built in accordance with the approved project at Wild Goose Island and Log Cabin Rapids.

The amount expended during the fiscal year ending June 30, 1897, was $3,898.92. The dikes at Log Cabin Rapids, 38 miles below Lewiston, and at Wild Goose Island Rapids, 73 miles below Lewiston, were completed and the parts previously built were repaired.

The dikes already built will be kept in repair and such other work in accordance with the project done as funds permit.

TABLE OF COMPARATIVE STATISTICS.

Exports and imports.

Year.	Tons.	Value.
1892 *a*	19,167	$600,000
1893 *a*	19,364	605,910
1894 *a*	9,854	225,000
1895 *a*	37,000	1,240,000
1896 *a*	15,520	548,000
1896 *b*	23,872	565,057

a Fiscal year. *b* Calendar year.

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July 1, 1896, balance unexpended	$6,666.97
June 30, 1897, amount expended during fiscal year	3,898.92
July 1, 1897, balance unexpended	2,768.05
Amount (estimated) required for completion of existing project	Indefinite.
Amount that can be profitably expended in fiscal year ending June 30, 1899	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix S S 10.)

11. Cowlitz River, Washington.—The first appropriation for this work was made in the river and harbor act approved June 14, 1880.

The Cowlitz is a northern tributary of the Columbia, and joins the latter river 64 miles above its mouth. The lower part of the river was seriously obstructed by snags and bars, with but little water on them during the low-water season. Many of the bars were the results of the accumulation of snags and drift.

The original project, adopted in 1878, contemplates the removal of sand bars, snags, rocks, and other obstructions for a distance of 50 miles above the mouth of the river. The cost of the work was estimated to be $5,000, with an additional annual expenditure of $2,000.

The amount expended to June 30, 1896, was $24,673.75. At that date the river had been kept cleared of the worst obstructions to navigation from its mouth to Toledo, a distance of 30 miles, and a bank revetment 2,000 feet long had been built a short distance below Toledo. The effect of the improvement had been to increase the available depth at low water somewhat and to add one month to the annual period of navigation.

The amount expended during the fiscal year ending June 30, 1897, was $2,014.75. The river below Toledo has been kept as thoroughly cleared of snags as possible. One hundred and twenty-nine large snags and many small ones, which were brought in by freshets, were removed.

The lower part of the river will be kept as thoroughly cleared of snags as possible.

TABLE OF COMPARATIVE STATISTICS.

Exports and Imports.

Year.	Tons.	Value.
1891 *a*	246,308	.....
1892 *a*	219,355	.....
1893 *a*	311,344	.....
1893 *b*	285,446	.....
1894 *b*	17,923	.....
1895 *b*	75,440	$292,881
1896 *b*	14,759	368,676

a Fiscal year. *b* Calendar year.

NOTE.—Previous to 1895 the values are not given.

July 1, 1896, balance unexpended	$3,326.25
June 30, 1897, amount expended during fiscal year	2,014.75
July 1, 1897, balance unexpended	1,311.50
July 1, 1897, outstanding liabilities	151.00
July 1, 1897, balance available	1,160.50
Amount (estimated) required for completion of existing project	Indefinite.
Amount that can be profitably expended in fiscal year ending June 30, 1899	3,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix S S 11.)

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12. Clearwater River, Idaho.—The only portion of the Clearwater River upon which navigation has been attempted is the portion extending from Kamai, on the Middle Fork, to the mouth of the river, at Lewiston, a distance of 69 miles. This stretch of the river has an average fall of 7 feet to the mile, and was obstructed by many rocks scattered throughout the upper portion and by bars of bowlders and large gravel on the lower portion. The controlling low-water depth on many of the bars was but a few inches.

The original project, adopted in 1879, provided for the improvement of the river so as to obtain a low-water depth of 4½ feet to the North Fork, and of 3 feet from the North Fork to the South Fork, by the removal of rock bowlders, gravel bars, and ledges, and the construction of such contraction works as might be necessary.

The estimated cost of this improvement was $34,424.

In 1883 another examination of the river was made, and it was found that the original estimates of the quantities to be removed to obtain the projected depths, as well as the unit costs of the same, were too low, and a revised estimate was submitted (published in Report of the Chief of Engineers for 1884, p. 2280), placing the cost of the work remaining at that time, to obtain the projected depth as far as the North Fork, at $87,000. No revised estimate was made of the cost of the work above the North Fork.

In the fall of 1896 a complete survey of the river from the junction of the Middle and South forks to the mouth was made. As a result of the information obtained by the survey, the project for obtaining a low-water navigation was abandoned and a project for obtaining a high-water navigation substituted.

The amount required to complete the improvement needed in accordance with the project for obtaining a high-water navigation was estimated to be $35,000.

The amount expended to June 30, 1896, was $15,000. At that date a partial improvement had been made as far as the North Fork, 41 miles above the mouth of the river.

The amount expended during the fiscal year ending June 30, 1897, was $7,170.83. A survey of the river from the junction of the Middle and South forks to the mouth was made and a number of rocks which obstructed high-water navigation removed.

Rock removal will be carried on as may be advantageous.

Shipping.—There are two boats which ply on the Clearwater River at times, carrying freight and passengers. They are of the stern-wheel class, and their registered gross tonnage is 539.92 and 502.35, respectively. Their draft of water fully laden is 4 feet 6 inches; light, 1 foot 9 inches.

The total number of passengers carried during the year 1896 was 697.

July 1, 1896, balance unexpended	$25,000.00
June 30, 1897, amount expended during fiscal year	7,170.83
July 1, 1897, balance unexpended	17,829.17
Amount (estimated) required for completion of existing project	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix S S 12.)

13. Kootenai River, Idaho, between Bonners Ferry and the international boundary line.—The first appropriation for this work was made in the river and harbor act of June 3, 1896.

The portion of the Kootenai River for which this appropriation is

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available is about 60 miles in length, has a gentle current, and a depth sufficient for navigation, but was obstructed by many snags which had lodged in the river.

A description of this part of the river is published in the Annual Report of the Chief of Engineers for 1893, pages 3456–3458.

The plan of improvement is to remove the snags in the river and the leaning trees on the banks which are liable to fall in and become obstructions. The estimated cost of the improvement is $5,000.

The amount expended during the fiscal year ending June 30, 1897, was $2,163.03. The worst snags were removed from about one-half the stretch of river to be improved.

The remaining snags in the river will be removed and any new snags coming in will be taken out as long as there are funds available.

Commercial statistics.

Class of goods.	Exports.		Imports.	
	Quantity.	Value.	Quantity.	Value.
	Tons.		*Tons.*	
Fruit and vegetables	377	$11,000		
Furs	1	9,000		
Grain	200	4,000		
Hay	300	3,000		
Lumber	105	600		
Merchandise	307	14,200		
Miscellaneous			10	$565
Wood, cord	300	450		
Total	1,590	42,250	10	565

The number of entries of vessels was 112, and number of vessels cleared, 112. The number of passengers carried was 500.

July 1, 1896, balance unexpended	$5,000.00
June 30, 1897, amount expended during fiscal year	2,163.03
July 1, 1897, balance unexpended	2,836.97

(See Appendix S S 13.)

14. Flathead River, Montana.—The portion of the Flathead River included within the limits for which this appropriation is available is about 27 miles in length. This portion of the river is of very gentle slope, running with many turns through a large area of low-lying lands, and has a minimum depth of about 10 feet, but is obstructed by a large number of snags which have accumulated in the river.

The plan of improvement is to remove the snags.

No estimate of the cost of this improvement has been made, and from its nature and a lack of information concerning the amount of work to be done none can be made.

The act of June 3, 1896, appropriated $10,000 for this improvement, but no work has yet been done.

The portion of the river to be improved will be cleared of snags.

No commercial statistics were collected for this improvement.

July 1, 1896, balance unexpended	$10,000.00
July 1, 1897, balance unexpended	10,000.00
Amount (estimated) required for completion of existing project	Indefinite.

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix S S 14.)

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EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The preliminary examinations and surveys of the following localities, required by the act of June 3, 1896, were made by the local engineer, Capt. Harry Taylor, Corps of Engineers, and reports thereon submitted through the division engineer, Col. Charles R. Suter, Corps of Engineers:

1. Preliminary examination of North Fork of Lewis River, Washington, to head of navigation, or Etna.—Captain Taylor submitted report of examination November 19, 1896. It is his opinion, concurred in by the division engineer and by the Chief of Engineers, that this stream is worthy of improvement by the General Government. A survey is not considered necessary to ascertain the character or cost of the improvement required. The report was transmitted to Congress and printed in House Doc. No. 80, Fifty-fourth Congress, second session. (See also Appendix S S 15.)

2. Preliminary examination of North River, Washington.—Captain Taylor submitted report of examination September 11, 1896. It is the opinion of the local officer, concurred in by the division engineer and by the Chief of Engineers, that North River, from its mouth for 25 miles upward, is worthy of improvement by the General Government. No survey is necessary to determine the character and extent of improvement required. The report was transmitted to Congress and printed in House Doc. No. 91, Fifty-fourth Congress, second session. (See also Appendix S S 16.)

3. Survey of Lewis River, Washington, from Columbia River to Lacenter.—Captain Taylor submitted report of survey May 12, 1897. The improvement proposed is to secure an increased depth in the river by the construction of training dikes, and by dredging and a limited amount of snagging on the lower river. The cost of the improvement is estimated at $20,460. In the opinion of the local officer, concurred in by the division engineer, the improvement is a worthy one and is justified by the interests of commerce involved. In view of the nature of the material forming some of the shoals to be improved, the possible desirability is suggested of changing the character of the dikes and their location and direction at the time when work on this stream shall be actually undertaken. The report was transmitted to Congress and printed in House Doc. No. 64, Fifty-fifth Congress, first session. (See also Appendix S S 17.)

4. Survey of Bellingham Bay, from deep water to the mouth of Whatcom Creek, at New Whatcom, Wash.—Captain Taylor submitted report of survey June 14, 1897. The improvement proposed is to dredge the Whatcom Creek waterway to a depth of 12 feet at mean lower low water, a channel 200 feet wide being provided as far as the existing railway bridge, and the waterway shoreward from this point to be dredged to its full size. The estimated cost of the work proposed is $80,000. It is the opinion of the local officer, concurred in by the division engineer, that the proposed improvement is a worthy one and justified by the interests of commerce involved. The report was transmitted to Congress and printed in House Doc. No. 80, Fifty-fifth Congress, first session. (See also Appendix S S 18.)

5. Survey of Kootenai River, Montana, for removal of obstructions above Jennings.—Captain Taylor submitted report of survey June 1, 1897. At the higher stages of the river there is but one point between Jennings and the international boundary line where difficulties to navigation are

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met with, this being at a canyon, or gorge, about 5 miles above Jennings. It is the opinion of the local officer that the danger and difficulty of navigating this canyon can be very materially reduced by the removal of the projecting points of rocks at B, and the breaking up and scattering of the large bowlders on the point C, as shown on the map accompanying the report, and possibly at some other places near by. The cost of the work is estimated at $5,000. The report was transmitted to Congress and printed in House Doc. No. 73, Fifty-fifth Congress, first session. (See also Appendix S S 19.)

EXAMINATIONS, SURVEYS, AND CONTINGENCIES OF RIVERS AND HARBORS.

For examinations, surveys, and contingencies of rivers and harbors an appropriation of $200,000 should be made, as follows:

For examinations, surveys, and contingencies, and for incidental repairs for rivers and harbors, for which there may be no special appropriation; for expenses connected with the inspection of bridges reported as obstructions to navigation, the service of notice required in such cases, and the location of harbor lines as required by the act of September 19, 1890; and for expenses connected with the examinations and reports by officers of the Corps of Engineers and by Boards of Engineers upon plans for bridges authorized by law to be constructed, and upon bridge bills, reports on which may be called for by Congress, $200,000.

SURVEY OF PORTLAND CHANNEL (CANAL), ALASKA.

The act of June 3, 1896, contained an item making appropriation of $5,000 for survey of Portland Channel (Canal), Alaska. This survey was assigned to the charge of Capt. D. D. Gaillard, Corps of Engineers.

Owing to the lateness of the assignment and the amount of money available, it was not deemed practicable to complete the work during the season of 1896, but Captain Gaillard was instructed to proceed to Alaska and make the necessary preliminary examination of the locality. He submitted a report November 3, 1896, giving the results of this examination.

The report was transmitted to Congress and printed in House Doc. No. 19, Fifty-fourth Congress, second session. (See also Appendix T T.)

SUPERVISION OF THE HARBOR OF NEW YORK.

The supervisor of the harbor during the year was Lieut. Commander Daniel Delehanty, United States Navy, to April 5, 1897, and Lieut. John F. Parker, United States Navy, since that date.

The office of supervisor of the harbor of New York was created by act of Congress approved June 29, 1888, entitled "An act to prevent obstructive and injurious deposits within the harbor and adjacent waters of New York City, by dumping or otherwise, and to punish and prevent such offenses." This act has been amended by section 3 of the act of August 18, 1894, entitled "An act making appropriations for the construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes," by which amendment the functions and powers of the officer have been greatly enlarged. Additional duties are also conferred on the supervisor by section 2 of the last-named act.

The following additional legislation regarding dumping in the port of New York was introduced in the charter of Greater New York:

CERTAIN SUBSTANCES NOT TO BE DUMPED IN PORT OF NEW YORK.

SEC. 880. The placing, discharging, or depositing, by any process or in any manner, of refuse, dirt, ashes, cinders, mud, sand, dredgings, sludge acid, or any other

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refuse matter, floatable or otherwise, in the tidal waters of the port of New York as defined by this act, except under permit of the United States supervisor of the harbor, is hereby strictly forbidden, and every person violating the foregoing provisions shall be guilty of a misdemeanor, and on conviction thereof shall be punished by a fine of not more than two hundred and fifty dollars nor less than five dollars, or imprisonment for not more than six months nor less than ten days, one-half of said fine to be paid to the person or persons giving information which shall lead to the conviction of such misdemeanor.

SCOWS TO RECEIVE ASHES, ETC., FROM STEAM TUGS AND VESSELS.

SEC. 881. The various scows employed by the city of New York, or by the contractors for removing ashes, garbage, and refuse of said city, while moored at the various dumping boards of said city, are hereby designated and required to receive directly any and all ashes or rubbish from any steam tug or steam vessel in the harbor, and in addition to the foregoing provisions two or more scows shall be located at such points within the harbor, as the supervisor of the harbor may direct, for the special use of boats and vessels wishing to discharge ashes or rubbish.

Under the provisions of section 5 of the act of June 29, 1888, a line officer of the Navy is designated to discharge the duties created by the act under the direction of the Secretary of War. On May 23, 1889, the Secretary of War directed that all communications in connection with these duties should be addressed to him through this office, and on February 1, 1890, he further directed that the powers conferred upon him by the act should be exercised through the Chief of Engineers.

The report of Lieutenant Parker, describing, for the fiscal year ending June 30, 1897, the operations in his charge, is submitted as Appendix U U.

The supervisor states in his report:

It will be readily seen from the foregoing that a constant and vigilant patrol of the bay and harbor by the boats of this office is imperative to protect the channels from probable violations of the law involved in the movement of the enormous amount of refuse of all kinds, averaging yearly about 10,000,000 cubic yards. The effect of this supervision is shown by the marked abatement of illicit deposits.

Estimates for the fiscal year ending June 30, 1899.—The estimate of funds required for this service for the fiscal year ending June 30, 1899, is given in the above-mentioned report, as follows:

For pay of inspectors, deputy inspectors, office force, and expenses of office.	$10,260
For pay of crews and maintenance of four steam tugs and three launches...	48,740
Total	59,000

MISSISSIPPI RIVER COMMISSION.

The Mississippi River Commission, constituted by act of Congress of June 28, 1879, is in charge of the improvement of the Mississippi River from the Head of the Passes to the mouth of the Ohio River, including the rectification of Red and Atchafalaya rivers at their junction with the Mississippi; the building of levees, and the improvement of the several harbors for which specific appropriations have been made, with the exception of the harbor of Vicksburg and the mouth of Yazoo River. It is also charged with the survey of the Mississippi River from the Head of the Passes to its head waters.

The Commissioners during the past fiscal year were: Col. G. L. Gillespie, Corps of Engineers, president; Lieut. Col. Amos Stickney, Corps of Engineers; Maj. Thomas H. Handbury, Corps of Engineers; Henry L. Whiting, assistant, United States Coast and Geodetic Survey, to February 4, 1897; B. M. Harrod, Robert S. Taylor, and Henry Flad. Henry L. Marindin, assistant, United States Coast and Geodetic Survey, has been a member of the Commission since March 22, 1897.

The report of the Commission upon the operations under its charge

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during the fiscal year ending June 30, 1897, is submitted as Appendix V V.

The work of the Commission is carried on under "the direction of the Secretary of War in accordance with the plans, specifications, and recommendations of the Mississippi River Commission as approved by the Chief of Engineers," and the work contemplated by law is the general improvement of the river, the building and repairing of levees, and surveys, the "improvement, surveys, building and repair of levees to be made and carried on in such manner as in their opinion shall best improve navigation and promote the interests of commerce at all stages of the river."

The project of the Commission, adopted in January, 1896, contemplates the building of levees, the annual dredging of channels through the shoal places and such minor bank work as may be necessary for the prevention of cut-offs, and the protection of harbors and threatened levee lines of exceptional importance.

During the year the levees on the Mississippi below Cairo were severely tested by the unprecedented high water which accompanied what is known as the flood of 1897. At all points below New Madrid (70 miles below Cairo) the water reached a higher stage than any other of which there is authentic record.

This flood is remarkable not only on account of its height but also by reason of its duration, the water remaining at about maximum stage at various points on the river for periods ranging from 11 to 58 days.

From information now at hand it appears that there were approximately 1,377 miles of levees on the two banks of the river between Cairo and the Head of the Passes and that the recent flood caused breaks in these aggregating in length only 8.7 miles, which is about .63 of 1 per cent of the whole length of the lines.

None of the levees built by the United States were broken.

The Commission states:

> The flood of 1897 has been a fruitful source of information to the Commission and to all those interested in the study of the hydraulics of the Mississippi River, or the economic problems involved in the development of the resources of its lower valley. It has furnished much useful data that were needed in the solution of the problems involved in the proper control of the high waters of the river and the protection of the valuable agricultural lands along its borders. It has pointed out the weak places in the present system of levees, and the defects in the methods of their construction. Better and more systematic planes of flood levels can now be established from Cairo to the Gulf than have heretofore been possible. The grade lines of levees can be established with some degree of assurance that they will not have to be raised within a few years; and the profiles can be determined for different localities with an equal degree of confidence. The district officers are now engaged in collecting the information bearing upon these points and when this comes to hand the Commission will be better prepared than formerly to submit an estimate for the construction of a levee system that will give promise of a satisfactory control of all future floods. From the information now at hand it is believed that this estimate will not vary in any great degree in aggregate yardage from that given in the report of the committee on levees, to be found with the last annual report of the Commission. [See Annual Report of the Chief of Engineers for 1896, part 6, p. 3460.] The amount there given as necessary to complete the system now adopted was 122,000,000 cubic yards. This at the estimate of 15 cents per yard would cost $18,300,000.
>
> The important fact that the flood waters of the Mississippi River may be permanently controlled by a system of levees that can be constructed within a limit of expense warranted by the advantages to be gained seems to have been fairly demonstrated by the flood of 1897.

The river and harbor act of June 3, 1896, provides for continued work for the improvement of the Mississippi River from the Head of the Passes to the mouth of the Ohio during four years, commencing July 1, 1897, the total expenditure during this period, as allotted by years, not to exceed $9,000,000. It is the understanding of the Chief of

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Engineers that of the sums thus pledged for the work it was the intention of Congress that not less than $763,300 should be expended for dredges and dredging. By the act of June 4, 1897, $600,000 of the allotment for year ending June 30, 1899, was made immediately available, with the proviso that such amount should be deducted from the allotment for year 1899. An estimate of $1,983,333 is therefore presented.

Estimate for the fiscal year ending June 30, 1899.—The following estimate of funds required for carrying on the works under the charge of the Commission for the year ending June 30, 1899, is submitted:

For improving Mississippi River from Head of the Passes to the mouth of the Ohio River, including salaries and clerical, office, traveling, and miscellaneous expenses of the Mississippi River Commission	$1,983,333
For improving harbor at—	
New Madrid, Mo	50,000
Memphis, Tenn	86,000
Helena, Ark	30,000
Greenville, Miss	100,000
Delta Point, La	150,000
Natchez, Miss., and Vidalia, La	317,000
New Orleans, La	300,000
For improvement at head of Atchafalaya and mouth of Red River, La	30,000
Total	2,996,333

MISSOURI RIVER COMMISSION.

The Missouri River Commission, constituted by act of Congress of July 5, 1884, is in charge of the improvement and surveys of the Missouri River below Sioux City, Iowa.

The Commissioners during the past fiscal year were Lieut. Col. Amos Stickney, Corps of Engineers, president; Maj. Thomas H. Handbury, Corps of Engineers; Maj. W. H. Heuer, Corps of Engineers; Garland C. Broadhead; R. S. Berlin to July 6, 1897, and C. L. Chaffee since that date.

The river and harbor act of August 18, 1894, in making appropriations for improvement of Gasconade and Osage rivers, Missouri, provided that the funds should be expended by the Missouri River Commission, and the work of improving these streams has since been carried on under its direction.

The report of the Commission upon operations under its charge during the fiscal year ending June 30, 1897, is submitted as Appendix W W. The Commission states:

The progress of the work for systematic improvement of the river by continuous work by reaches, which was started in 1891, has been seriously interfered with during the past year by the requirements of the river and harbor act of June 3, 1896, which specified numerous localities, separated by many miles, where work was to be done, notwithstanding the fact that the amount of money appropriated was largely reduced from that of previous years. In order to carry out the work indicated it was necessary to break up the organization of the work in one of the divisions of the first reach in order to supply forces and plant for detached works. The Osage division was seriously disorganized for this reason, and the work that was done in that division during the year was placed under the direction of the Gasconade division engineer, and it has been considered necessary for economical reasons to discontinue the Osage division altogether, merging it into the Gasconade division. The work in the Gasconade division has been much restricted.

The work heretofore done upon the first reach has extended from about 4 miles above Jefferson City to the Gasconade River, a distance of 45 miles, the whole length of the reach to the mouth of the river being 141 miles. The results obtained have shown beyond any question the practicability of controlling the river, holding its banks, and giving ample channels for navigation, but the cost and uncertainty of permanence of the work and slowness of progress have been such as to discourage the public and the National Congress in the effort to improve the river for such a

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distance as would give promise of the building up of its commerce and the benefiting of the general public to a degree commensurate with the cost of the work. The effect of this is plainly visible in the reduction of the appropriations and the yielding to demands for the application of considerable portions of the reduced appropriations to detached works in scattered localities where the interests of navigation do not require immediate work and where the only objects to be attained are the protection of local private interests.

The Commission and their executive officers have during the past year given much study and effort to the vital question of reduction of cost of work, in the hope that it might be so reduced as to make that part of the improvement of the river confided to the Commission such in cost, efficiency, and rate of progress as would insure early and sufficient benefit to the general public and to such a degree as to commend the improvement as being wise and worthy of its making.

It is believed that much progress has been made toward a very great decrease in the cost of work that will not only be efficient in accomplishing the purposes of the improvement, but in making it permanent. The principal work on the river consists of dikes for regulating the width and directing the channels and work for protection of banks. Modifications of dike construction and new methods of bank protection have been tried, with most promising results; but it is yet too early in the progress of these efforts to assert with perfect confidence that the entire work of improvement can be made at a very great decrease from the cost of methods heretofore used. Unceasing efforts will be put forth to accomplish a result so much to be desired.

* * * * * * *

It is earnestly urged that when it may be deemed proper to provide for work at specified localities on the river not included in the systematic work in progress, separate additional appropriations should be made, so that the systematic work and the maintenance of plant may not be left unprovided for by the diversion of funds to other purposes.

The systematic plan under which the Commission is working, to such an extent as the appropriation acts permit, is that of the permanent improvement of the river in reaches, commencing at the lowest reach, as provided for by law. It is only by the application of appropriations to such systematic work that the improvement of the Missouri River can be accomplished. Allotments from the appropriation for work in detached localities can do but little good at such points, and all such allotments interfere materially with the progress of the systematic improvements, increase its cost, and postpone the time when commerce will commence to reap full benefit from the improvement.

Estimate for the fiscal year ending June 30, 1899.—The following estimate of funds required for carrying on the works under the charge of the Commission for the year ending June 30, 1899, is submitted, being for the amount authorized by the act of June 3, 1896:

Improving Missouri River from mouth to Sioux City, Iowa, including office and traveling expenses and salaries of Commission, surveys, gauges, physical data and publications, operating snag boat, and systematic improvement of first reach	$300,000
Improving Osage River, Missouri:	
For completion of lock and dam	146,000
Snagging, etc	4,000
Total	150,000
Improving Gasconade River, Missouri:	
Snagging, etc	15,000

CALIFORNIA DÉBRIS COMMISSION.

Act of Congress approved March 1, 1893, provided for the establishment of the California Débris Commission, to consist of three officers of the Corps of Engineers, appointed by the President, with the concurrence of the Senate, whose functions relate to hydraulic mining in the territory drained by the Sacramento and San Joaquin river systems

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in California. The Commission is empowered and required to adopt plans for improving the navigation of the rivers in the systems mentioned, to project and construct works for impounding detritus and preventing the deterioration of the rivers from the deposit of hydraulic mining and other débris, and to devise means and issue permits for resuming and carrying on hydraulic mining operations under conditions that will not injure other interests in the State. The powers of the Commission, methods of procedure, etc., are prescribed in the act in detail.

The Commissioners during the past fiscal year were Col. Charles R. Suter, Maj. Charles E. L. B. Davis, and Capt. Cassius E. Gillette, Corps of Engineers.

The report of the Commission upon operations during the fiscal year ending June 30, 1897, is submitted herewith as Appendix X X.

Estimate for the fiscal year ending June 30, 1899.—The Commission submits an estimate amounting to $15,000 for payment of the necessary expenses of the Commission during the fiscal year ending June 30, 1899.

BRIDGING NAVIGABLE WATERS OF THE UNITED STATES.

Plans and maps of locations of the following bridges, proposed to be erected under the authority of special acts of Congress, have been examined with a view to protection of the interests of navigation, and have been approved by the Secretary of War, as provided by the acts; and the local engineer officers have been furnished with copies of the instruments of approval and drawings showing plans and locations, and charged with the supervision of the construction of the bridges so far as necessary to see that they are built in accordance with the approved plans:

1. Bridge of the Boonville and Howard County Bridge Company across Missouri River at Boonville, Mo.—Plans and map of location of this bridge, proposed to be built under authority of an act of Congress of May 25, 1896, were submitted July 22, 1896; approved by the Secretary of War September 11, 1896.

2. Bridge of the Yankton Bridge Company across Missouri River at Yankton, S. Dak.—Plans for the construction of this bridge under authority of an act of Congress approved June 22, 1892, were approved by the Secretary of War August 3, 1894. (See Annual Report of Chief of Engineers for 1894, p. 425.)

Subsequently, July 15, 1896, plans were submitted providing for lengthening the two main spans on north end and slightly increasing the elevation; approved by the Secretary of War September 11, 1896. Plans in lieu of these were afterwards approved by the Secretary on November 23, 1896.

3. Bridge of the Union Railroad Company across Monongahela River between Port Perry and Mifflin Township, Pennsylvania.—The construction of this bridge was authorized by act of Congress approved January 26, 1897.

Plans and map of location, to be in lieu of plans approved by the Secretary of War October 2, 1896, for bridge between Mifflin and Wilkins townships, were submitted January 30, 1897, and modified plans were received February 23, 1897. The modified plans were approved by the Secretary of War March 8, 1897.

4. Bridge of the city of Detroit, Mich., across west channel of Detroit River.—Plans for the reconstruction of this bridge, originally built

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under authority of an act of Congress approved July 20, 1886, were submitted March 26, 1897; approved by the Secretary of War April 8, 1897.

5. Bridge of the Braddock and Duquesne Bridge Company across Monongahela River between Braddock and Mifflin townships, Pennsylvania.—Plans and map of location for a bridge at this place, proposed to be built under authority of an act of Congress approved January 26, 1897, were submitted March 31, 1897; approved by the Secretary of War April 10, 1897.

6. Bridge of the Aransas Harbor Terminal Railway Company across Corpus Christi Channel (Morris and Cummings Ship Channel), Texas.—Plans and map of location for a bridge at this place, proposed to be built under authority of an act of Congress approved May 4, 1896, were submitted March 18, 1897; approved by the Secretary of War April 21, 1897.

7. Bridge of the Delta Cooperage Company and the Yazoo and Mississippi Valley Railroad Company across Tallahatchie River at Philipp, Miss.—Plans and map of location of this bridge, proposed to be built under authority of an act of Congress approved May 28, 1896, were submitted May 14, 1897; approved by the Secretary of War June 1, 1897.

8. Bridge of Roane County across Clinch River at Kingston, Tenn.—Plans and map of location for a bridge to be built at this place, under authority of an act of Congress approved June 9, 1897, were submitted May 10, 1897; approved by the Secretary of War June 10, 1897.

9. Bridge of the Mobile and Ohio Railroad Company across Cahaba River, in Bibb County, Ala.—Plans and map of location for a bridge proposed to be constructed at this place, under authority of an act of Congress approved June 11, 1896, were submitted May 31, 1897; approved by the Secretary of War June 16, 1897.

10. Bridge of the Mobile and Ohio Railroad Company across Alabama River near Montgomery, Ala.—The construction of a bridge at this locality by the Alabama Great Northwestern Railway Company, afterwards the Montgomery, Tuscaloosa and Memphis Railway Company, was authorized by act of Congress approved August 6, 1888, and plans were approved by the Secretary of War August 5, 1889 (see Annual Report of Chief of Engineers for 1890, p. 336), under which construction was begun.

Subsequently, by act of Congress of June 11, 1896, this franchise was granted to the Mobile and Ohio Railroad Company, which presented plans June 10, 1897, for building the bridge upon a different site from that originally approved. The plans were approved by the Secretary of War June 16, 1897.

11. Bridge of Marion County, Miss., across Pearl River.—The construction of this bridge was authorized by act of Congress approved June 18, 1897. Plans and map of location were received February 8, 1897; approved by the Secretary of War July 1, 1897.

12. Bridge of the city of Monroe, La., across Ouachita River at De Siard street.—The construction of this bridge was authorized by act of Congress approved February 8, 1897. Plans and map of location were submitted June 12, 1897; approved by the Secretary of War July 2, 1897.

13. Bridge of the Mobile and Ohio Railroad Company across Warrior River, in Tuscaloosa County, Ala.—Plans and map of location for a bridge proposed to be built at this locality, authorized to be constructed by act of Congress approved June 11, 1896, were submitted June 8, 1897; approved by the Secretary of War August 19, 1897.

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14. Bridge of the St. Francis Bridge and Turnpike Company across Lake St. Francis at or near Lake City, Ark.—The construction of this bridge was authorized by act of Congress approved March 6, 1896. Plans and map of location were submitted July 19, 1897; approved by the Secretary of War August 24, 1897.

15. Bridge of the Northern New York Railroad Company across St. Lawrence River near Hogansburg, N. Y.—Plans and map of location for a bridge proposed to be built at this place under authority of an act of Congress approved March 2, 1897, were submitted July 14, 1897, and modified plans August 21, 1897; approved by the Secretary of War August 25, 1897.

Under the provisions of section 7 of river and harbor act approved September 19, 1890, amended by section 3 of river and harbor act approved July 13, 1892, bridges may be built over navigable waters entirely within the limits of any State, under the authority of legislative enactment of such State, when the plans and locations of the structures are approved by the Secretary of War. Plans and maps of locations of the following bridges proposed to be erected under these provisions have been examined, with a view to protection of the interests of navigation, and have been approved by the Secretary of War; and the local engineer officers have been furnished with copies of the drawings and instruments of approval, and charged with the supervision of construction of the bridges so far as necessary to see that they are built in accordance with the approved plans:

1. Bridge of the Texarkana and Fort Smith Railway Company across Neches River at Beaumont, Tex.—Plans and map of location were submitted August 11, 1896; approved by the Secretary of War September 12, 1896.

2. Bridge of the Seattle and Rainier Beach Railway Company across Black River, Washington.—Plans and map of location were submitted August 28, 1896; approved by the Secretary of War September 11, 1896.

3. Bridge of the Kansas City, Shreveport and Gulf Railway Company across Calcasieu River at Lake Charles, La.—Plans and map of location were submitted August 17, 1896; approved by the Secretary of War September 14, 1896.

4. Bridge of the Lake Shore and Michigan Southern Railway Company across Swan Creek at Toledo, Ohio.—Plans for the construction of a bridge to replace the existing structure at this place were submitted July 6, 1896; approved by the Secretary of War September 15, 1896.

5. Bridge of the Kansas City, Osceola and Southern Railway Company across Osage River at Osceola, Mo.—Plans and map of location were received September 2, 1896, and were approved by the Secretary of War September 18, 1896, upon condition that a pivot pier be substituted for one of the common piers shown on the plans.

Subsequently, upon application of the company, October 17, 1896, this condition was revoked and the plans originally presented were approved by the Secretary of War November 23, 1896, upon condition that the company agree to construct a pivot pier whenever so directed to do by the Secretary of War, this approval to be in lieu of that of September 18, 1896.

6. Bridge of Bristol County, Mass., across Acushnet River between New Bedford and Fairhaven.—Plans for the construction of this bridge from Fairhaven to Popes Island were approved by the Secretary of War June 23, 1896 (see Annual Report of Chief of Engineers for 1896, p. 426).

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Modified plans, involving a change in the method of constructing foundations of piers and abutments from that proposed by the approved plans, were submitted September 8, 1896; approved by the Secretary of War September 23, 1896.

Plans for the construction of a second portion of this bridge, between Popes Island and Fish Island, were submitted June 28, 1897; approved by the Secretary of War July 17, 1897.

7. Bridge of the Queen Anne's Railroad Company across Choptank River at Denton, Md.—Plans and map of location were submitted August 13, 1896; approved by the Secretary of War September 23, 1896.

8. Bridge of the city of New York across East River at Delancey street.—Plans for the construction of a bridge at this place by the East River Bridge Company were approved by the Secretary of War February 16, 1893 (see Annual Report of Chief of Engineers for 1893, p. 467).

The rights and franchises of the company in this bridge having been acquired by the city of New York, plans and map of location were submitted January 10, 1896. The plans were considered by The Board of Engineers at New York, who recommended in report of February 26, 1896, that a bridge at this locality should be required to have a clear headway of 135 feet at mean high spring tides, under most unfavorable conditions as to load and temperature, for 200 feet on each side of the middle point of the bridge and a height at the pierhead lines of at least 117 feet.

Modified plans conforming to the requirements of The Board were submitted September 15, 1896; approved by the Secretary of War September 24, 1896.

9. Bridge of the city of Appleton, Wis., across United States Fox River Canal at John street.—Plans for a bridge to replace the existing structure at this place were submitted September 2, 1896; approved by the Secretary of War October 10, 1896.

10. Bridge of the city of Green Bay, Wis., across East River.—Plans for the construction of this bridge were approved by the Secretary of War May 1, 1896 (see Annual Report of Chief of Engineers for 1896, p. 426).

Application was made by the city September 30, 1896, for approval of plans for a protection pier for this bridge, which contemplated a modification of the approved plans by slightly reducing the width of the draw opening. Approved by the Secretary of War October 13, 1896.

11. Bridge of the city of Green Bay, Wis., across Fox River at Main street.—Plans for a bridge to replace the existing structure at this place were submitted September 30, 1896; approved by the Secretary of War October 14, 1896.

12. Bridge of Monmouth and Ocean counties, New Jersey, across Manasquan River between Manasquan and Point Pleasant.—Plans for a bridge to replace the existing structure at this place were submitted October 17, 1896; approved by the Secretary of War November 9, 1896.

13. Bridge of the town of Jeanerette, La., across Bayou Teche.—Plans and map of location were submitted September 24, 1896; approved by the Secretary of War November 13, 1896.

14. Bridge of Essex County, Mass. (*Essex Bridge*), *across Beverly Harbor between Salem and Beverly.*—Plans for rebuilding the draw of this bridge and for the construction of a temporary bridge to be used during the reconstruction were submitted October 31, 1896; approved by the Secretary of War November 19, 1896.

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15. Bridge of the Superior Rapid Transit Railway Company and the Duluth Street Railway Company across St. Louis River between Duluth, Minn., and Superior, Wis.—Plans and map of location for a temporary pile and trestle bridge proposed to be built at this place were submitted November 11, 1896; approved by the Secretary of War November 20, 1896.

16. Bridge of Shasta County, Cal., across Sacramento River at Balls Ferry.—Plans and map of location were submitted October 31, 1896; approved by the Secretary of War December 8, 1896.

17. Bridge of the New York, New Haven and Hartford Railroad Company across Pequonnock River at Bridgeport, Conn.—Plans and map of location were submitted April 15, 1896. These plans being objectionable, modified plans were received from the company November 10, 1896; approved by the Secretary of War December 10, 1896.

18. Bridge of the West Braddock Bridge Company across Monongahela River at Rankin, Pa.—Plans for the construction of this bridge were approved by the Secretary of War July 20, 1896 (see Annual Report of Chief of Engineers for 1896, p. 424).

Plans providing for a modification of the approved plans, to permit a lateral shifting of the channel span, slightly increasing the span, to remove one pier from the river and substitute one span for two short ones, were submitted December 3, 1896; approved by the Secretary of War December 21, 1896.

19. Bridge of the town of Hempstead, N. Y., across Long Beach Channel from Barnum Island to Inner Beach.—Plans and map of location were submitted August 1, 1896; approved by the Secretary of War, December 24, 1896.

20. Bridge of the city of Menasha, Wis., across Fox River.—Plans for a bridge to replace the existing structure at this place were submitted December 14, 1896; approved by the Secretary of War December 29, 1896.

21. Bridge of the town of Oyster Bay, N. Y., across Mill Neck Creek Inlet from Allens Point at Mill Neck to Pine Island at Bayville.—Plans and map of location were submitted October 28, 1896; approved by the Secretary of War January 5, 1897.

22. Bridges of the Chicago and Northwestern Railway Company across Kinnickinick River at Milwaukee, Wis.—Plans for the reconstruction of the existing bridge at this place and for a temporary bridge to be maintained during the construction of the new bridge were submitted December 12, 1896; approved by the Secretary of War January 13, 1897.

23. Bridge of New York, Philadelphia and Norfolk Railroad Company across the Southern Branch of Elizabeth River at Norfolk, Va.—Plans and map of location were submitted December 24, 1896; approved by the Secretary of War February 8, 1897.

24. Bridge of the Astoria and Columbia River Railroad Company across Blind Slough, Oregon.—Plans and map of location were submitted May 22, 1896; approved by the Secretary of War March 8, 1897.

25. Bridge of the St. Joseph Valley Railway Company across St. Joseph River, Michigan.—Plans and map of location were submitted November 2, 1896; approved by the Secretary of War March 11, 1897.

26. Bridge of Jefferson County, Texas, across Hillebrandt Bayou.—Plans and map of location were submitted March 2, 1897; approved by the Secretary of War March 30, 1897.

27. Bridge of the Allegheny and Westmoreland Bridge Company across Youghiogheny River at Suterville, Pa.—Plans for the construction of this

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bridge were approved by the Secretary of War December 30, 1895 (see Annual Report of Chief of Engineers for 1896, p. 425).

The approved plans provided for a suspension bridge, but a truss bridge was built and plans for such a bridge were submitted for approval March 27, 1897; approved by the Secretary of War April 13, 1897.

28. Bridge of the city of Philadelphia, Pa., across Schuylkill River.—Plans and map of location were submitted February 26, 1897; approved by the Secretary of War April 17, 1897.

29. Bridge of the city of New Haven, Conn., across Mill River at Chapel street.—Plans and map of location were submitted April 17, 1897; approved by the Secretary of War April 29, 1897.

30. Bridge of Mr. J. B. Levert across Bayou Teche, in St. Martin Parish, La.—Plans and map of location were submitted April 12, 1897; approved by the Secretary of War April 29, 1897.

31. Bridge of the Houston, East and West Texas Railway Company across Trinity River above Marianna, Tex.—Plans for a bridge to replace the existing structure at this place were submitted April 17, 1897; approved by the Secretary of War May 8, 1897.

32. Bridge of the town of Yarmouth, Me., across Casco Bay, between Cousins and Littlejohns islands.—Plans and map of location were submitted May 10, 1895; approved by the Secretary of War May 8, 1897.

33. Bridge of the Lake Shore and Michigan Southern Railway Company across Ashtabula River at Ashtabula, Ohio.—Plans and map of for a bridge to replace the existing structure at this place were location submitted March 11, 1897; approved by the Secretary of War May 11, 1897.

34. Bridge of the city of Brooklyn, N. Y., across Coney Island Creek from West Seventeenth street to West Eighteenth street.—Plans and map of location were submitted May 18, 1897; approved by the Secretary of War May 28, 1897.

35. Bridge of the city of Manitowoc, Wis., across Manitowoc River at Main street.—Plans for the construction of a bridge at this place, to replace the existing structure, were submitted May 28, 1897; approved by the Secretary of War June 16, 1897.

36. Bridge of the Portsmouth, Kittery and York Street Railway Company across Piscataqua River Channel between Kittery and Badgers Island, Maine.—Plans and map of location were submitted June 5, 1897; approved by the Secretary of War June 18, 1897.

37. Bridge of the Portsmouth, Kittery and York Street Railway Company across Brave Boat Harbor between Kittery and York, Me.—Plans and map of location were submitted June 5, 1897; approved by the Secretary of War June 18, 1897.

38. Bridge of the city of Port Huron, Mich., across Black River at Tenth street.—Plans and map of location were submitted May 27, 1897; approved by the Secretary of War June 29, 1897.

39. Bridges of the town of Bourne, Mass., across Monument and Back rivers.—Plans and maps of location were submitted June 9, 1897; approved by the Secretary of War July 3, 1897.

40. Bridge of St. Martin Parish, La., across Bayou Teche at St. Martinville.—Plans and map of location were received July 1, 1897; approved by the Secretary of War July 28, 1897.

41. Bridge of Walton County across Alequa Creek near Portland, Fla.—Plans and map of location were submitted July 10, 1897; approved by the Secretary of War August 11, 1897.

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42. Temporary bridge of the Union Street Railway Company across Acushnet River between Popes Island and Fish Island, New Bedford Harbor, Massachusetts.—For the purpose of maintaining uninterrupted travel between New Bedford and Fairhaven, Mass., during reconstruction of the county bridge between Popes and Fish islands, plans for a temporary trestle bridge between these points were submitted July 15, 1897; approved by the Secretary of War, by revocable permit, August 20, 1897.

43. Bridge of the Vermont and Province Line Railroad Company across Missisquoi Bay at Alburgh Point, Vt.—Plans and map of location were submitted May 28, 1897, and modified plans August 6, 1897; approved by the Secretary of War August 20, 1897.

44. Bridge of Iberville Parish across Bayou Plaquemine at Plaquemine, La.—Plans and map of location were submitted August 10, 1897; approved by the Secretary of War August 31, 1897.

Under the provisions of sections 4 and 5 of the river and harbor act approved September 19, 1890, relating to bridges obstructing navigation, plans for alteration of the following bridges, so as to render navigation unobstructed, have been examined and approved by the Secretary of War; and the local engineer officers have been furnished with copies of the plans and instruments of approval and charged with supervision of the work of alteration so far as necessary to see that the approved plans are complied with:

1. Bridge of the Central Pacific Railroad Company across Oakland Harbor at Harrison street, Alameda, Cal.—Complaint having been made against the bridge over Oakland Harbor at Alice street, operated by the Southern Pacific Company, proceedings were instituted and notice of the Secretary of War, dated May 20, 1896, requiring the bridge to be so altered as to provide a draw of not less than 150 feet clear opening, the draw to be operated by other than hand power, was served on the company May 29, 1896, (see Annual Report of Chief of Engineers for 1896, p. 428).

In lieu of carrying out the orders of the War Department, plans for a new bridge at Harrison street to replace the existing structure at Alice street were presented by the Southern Pacific company and the Central Pacific Railroad Company; approved by the Secretary of War April 30, 1897.

2. Bridge of the city of Brooklyn and the county of Queens, N. Y., across Newtown Creek, at Vernon avenue, Long Island City.—Complaint having been made against the existing bridge at this place, plans for its reconstruction were submitted by the authorities of Kings and Queens counties and were approved by the Secretary of War May 7, 1895 (see Annual Report of Chief of Engineers for p. 481).

Revised plans, to be in lieu of those originally approved were submitted November 10, 1896; approved by the Secretary of War November 21, 1896.

3. Bridge of the city of Portland (Tukeys Bridge), across Back Cove, Portland Harbor, Maine.—The existing bridge at this place being considered an obstruction to navigation, notice to alter the same, dated August 13, 1894, was served on the mayor of Portland August 16, 1894 (see Annual Report of Chief of Engineers for 1895, p. 482).

Plans for reconstruction of the bridge were submitted January 26, 1897; approved by the Secretary of War February 10, 1897.

Modified plans providing for a reduction of the width of draw opening to 67 feet instead of 70 feet, as proposed in approved plans, were submitted May 10, 1897; approved by the Secretary of War May 26, 1897.

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BRIDGES OBSTRUCTING NAVIGATION.

Under the requirements of sections 4 and 5 of the river and harbor act approved September 19, 1890, the Secretary of War notified the persons, corporations, or associations owning or controlling certain bridges obstructing navigation, after giving them a reasonable opportunity to be heard, to so alter said bridges as to render navigation through or under them reasonably free, easy, and unobstructed, specifying in the notice the alterations required to be made, and prescribing a reasonable time in which to make them, as follows:

Bridge of the city of New York across Harlem River at One Hundred and Fifty-sixth street.—A revocable license for the construction of a temporary bridge at this place was granted by the Secretary of War July 5, 1892, the license to expire upon completion of the bridge at One hundred and fifty-fifth street and McCombs Dam road unless sooner revoked.

The bridge at One hundred and fifty-fifth street having been completed and complaint having been made against the bridge at One hundred and fifty-sixth street as being a menace to navigation, notice of the Secretary of War, dated April 7, 1897, requiring removal of the bridge within ninety days, was served on the commissioners of public parks April 13, 1897.

OCCUPANCY OF AND INJURY TO PUBLIC WORKS BY CORPORATIONS AND INDIVIDUALS.

Under the requirements of section 2 of the river and harbor act approved July 5, 1884, and section 4 of the river and harbor act approved August 5, 1886, there are submitted herewith reports of officers in charge of river and harbor districts of instances in which piers, breakwaters, or other works built by the United States in aid of commerce or navigation are used, occupied, or injured by corporations or individuals. (See Appendix Y Y.)

MISCELLANEOUS.

[Public works not provided for in acts making appropriations for the construction, repair, and preservation of works on rivers and harbors.]

REPAIR OF THE AQUEDUCT BRIDGE ACROSS POTOMAC RIVER AT WASHINGTON, D. C.

This work was in the charge of Lieut. Col. Chas. J. Allen, Corps of Engineers.

In compliance with Senate resolution, January 21, 1893, an examination of the piers of this bridge was made with the aid of a diver. A report in detail of the examination was rendered June 21, 1893, and on the 17th of July following an estimate of the cost of repairs was submitted. By act of August 18, 1894, an appropriation of $51,070 was made for the repairs. Under this appropriation Piers Nos. 2, 3, 5, 6, 7, and 8 were repaired by means of Portland cement concrete in bags, placed by a diver, and the repair of Pier No. 4 was made by means of a coffer-dam within which new masonry was laid in a large eroded cavity at the upstream end of the pier. This work was completed in August, 1895.

As the work of repairs proceeded, it was found that the old masonry of the pier, which was built about 1838, had not been started from solid rock and that part of it was of poor quality. There was also a crack in the masonry extending nearly throughout the entire height of

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the pier. It was decided that it would be necessary before long to remove the defective masonry in the remainder of the pier and replace it by masonry of proper quality founded on the solid rock. The existing appropriation was insufficient for this purpose, and it was therefore necessary to ask a further appropriation. As the cofferdam would be needed for the proposed work, it was purchased from the contractors upon completion by them of their work in 1895.

The unexpended balance of the appropriation, amounting to $4,690.30, was covered into the Treasury.

A full report and estimate of the cost of removing all the old masonry of the pier from the coping down to the bottom and rebuilding from the bottom up was rendered under date of November 30, 1895, and printed as House Doc. No. 158, Fifty-fourth Congress, first session, and in the Annual Report of the Chief of Engineers for 1896, page 3886. The cost was estimated at $65,000, which sum was appropriated for reconstruction of Pier No. 4 by act of Congress of June 8, 1896.

A contract for the work of reconstruction of that pier was made with the Houston Construction Company, of Philadelphia, Pa., May 17, and approved May 28, 1897. The total estimated amount of the contract is $30,000.

By the close of the fiscal year the contractors had most of their plant in position on the cofferdam and had made some progress in quarrying rock for the work. By the terms of the contract the work is to be completed by November 1 next.

Amount appropriated by act of June 8, 1896		$65,000.00
June 30, 1897, amount expended during fiscal year		1,446.43
July 1, 1897, balance unexpended		63,553.57
July 1, 1897, outstanding liabilities	$436.00	
July 1, 1897, amount covered by uncompleted contracts	30,000.00	
		30,436.00
July 1, 1897, balance available		33,117.57

(See Appendix Z Z.)

MAINTENANCE AND REPAIR OF WASHINGTON AQUEDUCT, AND INCREASING THE WATER SUPPLY OF WASHINGTON, D. C.

These works were in the charge of Capt. D. D. Gaillard, Corps of Engineers, to August 17, 1896; in the temporary charge of Lieut. Col. Chas. J. Allen, Corps of Engineers, from August 17 to November 16, 1896; and in the charge of Captain Gaillard since November 16, 1896.

1. Washington Aqueduct.—Gatehouses and other buildings were repaired. The former were repointed and covered with a wash of Portland cement; the latter were repainted or whitewashed. About 4.5 miles of picket and board fences were repaired and whitewashed.

During the past year, not including the occasions when the water level was lowered by the supply being shut off for the purpose of making repairs or of removing deposits from the conduit, the extreme fluctuation of water level in the distributing reservoir had a range of but 1 foot, as against 1.8 feet for the preceding year. This marked improvement is due to three causes: (1) Raising the dam at Great Falls; (2) removing deposits from the conduit; (3) putting the Dalecarlia Reservoir into service.

The borders of the Dalecarlia Reservoir have been cleared of underbrush and fallen trees; the more irregular banks have been graded, and the shallow, marshy portions partly filled and partly deepened.

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The spillway was extensively repaired and a gauging-weir built to measure its overflow. All cracks in the bottom and along the sides of the high-service reservoir in Georgetown were plastered up and the entire interior was covered with several washes of Portland cement to prevent exfiltration.

During May and June, 1897, for the second time since completion, all deposits (aggregating 170 cubic yards) were removed from the conduit, and the interior was carefully scraped and swept. An inspection of the entire interior of the conduit shows that none of the cracks plastered up in 1896 have reopened and that no new ones have developed.

The north connection of the by-conduit around the Dalecarlia Reservoir is in bad condition, rendering it unsafe to enter it to remove deposits, and permitting interchange of its waters with those of the reservoir.

One thousand seven hundred and fourteen cubic yards of flint stone and 356 cubic yards of blue stone were obtained for the repair of the Conduit Road. All of the blue stone and 1,044 cubic yards of flint stone were crushed and spread upon the road, when the breaking of the crusher and lack of funds prevented further work during the fiscal year. Extensive repairs were made to the dirt road, 2½ miles in length, between the Anglers Club House and Great Falls.

Travel on the Conduit Road has increased so greatly during recent years that it is impossible to keep up the present condition of the road out of the annual appropriation for the operation, preservation, and repair of the Washington Aqueduct, without detriment to other more vital parts of the aqueduct system, and a separate annual appropriation for this purpose is recommended.

General repairs, such as cleaning out culverts and ditches, cutting down bushes, and trimming slopes, were made to the entire road between Georgetown and Great Falls.

The ordinary inspection of mains and repairs of leaks therein, oiling and working of valves and blow-offs, packing of valve pipes to prevent freezing, and investigations of applications for permission to tap mains were carried on during the year.

With the appropriation of June 11, 1896, for this purpose, one 12-inch blow-off and six 3-inch air valves were inserted in the 36-inch main, and four blow-offs and nine air valves were inserted in the 30-inch main.

In addition, one 12-inch blow-off was inserted in the 48-inch main and paid for out of the regular annual appropriation for the Washington Aqueduct.

By the use of a special tapping machine all of this work was accomplished without at any time shutting off the water from the mains.

The telephone line between the office in Washington and Great Falls was extensively repaired, but does not afford satisfactory service. By act of March 3, 1897, an appropriation of $5,000 was made for constructing a new telephone line between the Washington Aqueduct Office and Great Falls, Maryland. With this appropriation, a new line, equipped with the best long-distance telephone, will be constructed early in the next fiscal year.

A complete report is made of all encroachments on the Aqueduct lands and all matters occurring during the year relating to these lands.

Measurements of the daily and hourly consumption and waste of water were made on June 23–24 and 29–30, 1897, and a mean of the two results gave the daily consumption as 45,267,047 gallons, a slight increase above that of the preceding year. Based upon an estimate of 261,478 consumers of Potomac water, as given by the assistant in charge of the water department of the District, this corresponds to a per capita daily consumption and waste of 173 gallons. Based upon a popu-

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lation of 277,782 in the District of Columbia, as determined by the police census taken in April, 1897, irrespective of their source of water supply, it corresponds to a daily per capita of 163 gallons.

An extensive series of gaugings, by current-meter observations in the conduit, at two stations, discloses the fact that at the lowest stage of the Potomac, with all deposits removed from the conduit and the distributing reservoir about 2 feet below its present level (146 feet above datum), the conduit is capable of discharging into that reservoir about 76,500,000 gallons per day.

This represents the ultimate capacity of the conduit, and the present daily consumption is about 60 per cent of this amount. Ten years ago it was but 35 per cent of the same amount. The necessity, therefore, for the construction of a new conduit between Great Falls and the distributing reservoir is only a question of time.

The new conduit should be completed and ready for operation before the daily consumption equals the maximum capacity of the present conduit. To make the preliminary surveys and plans, acquire the necessary lands, and construct the conduit will involve operations extending over several years; therefore the inauguration of this work should not long be deferred. The officer in charge states that estimates for the preliminary operations will be submitted in the next Annual Report. The trunk mains leading to the city, however, are already overtaxed in supplying the present consumption of a little more than 45,000,000 gallons per day, and every increase in their volume of flow will be marked by a rapid decrease in pressures in those parts of the city supplied by gravity alone. It appears, therefore, that while the conduit is capable of supplying over 30,000,000 gallons per day in excess of the present rate of consumption, the trunk mains have reached the limit of efficient discharge, and consumers will receive but little benefit from the increased discharge of the conduit unless some method is provided for bringing an additional supply of the water from the distributing reservoir into the city.

Upon recommendation of the Chief of Engineers, approved by the Secretary of War, an expert commission was appointed to meet in Washington in December, 1895, to report upon the feasibility of completing the tunnel conduit. After a careful study of the subject and a thorough inspection of the tunnel conduit and the works connected therewith, the commission submitted their report (published in House Doc. No. 166, Fifty-fourth Congress, first session), which concluded with the statement, "That it is our unanimous judgment that it is feasible to complete the tunnel conduit, with its appurtenances, ready for service, for the sum of $897,837, as stated in our estimate, and we believe that such completion will not be impracticable or too expensive, inasmuch as we know of no more economical method for bringing increased water supply from the reservoir in Georgetown to Washington by pipes or otherwise." As an essential part of this system, it is necessary to complete the new reservoir near Howard University at an estimated additional cost of $198,013.30, making the total cost of the whole work $1,095,850.30.

There is a balance of about $290,000 of the appropriations made by the act of 1882 and subsequent acts for "Increasing the water supply of Washington, D. C.," remaining unexpended in the Treasury of the United States.

By making this sum available for expenditure on the work and appropriating an additional sum of $805,850.30 the whole amount estimated by the commission as necessary to complete would be provided.

I recommend, in view of the foregoing, that the aforesaid balance be

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made immediately available for expenditure, and that the further sum of $805,850.30 be appropriated, also to be immediately available, for the work of resuming and completing the tunnel conduit between the distributing reservoir and the new reservoir near Howard University and for the other works connected therewith, including the latter reservoir.

Estimates are submitted for repairing the north connection of the by-conduit at the Dalecarlia Reservoir; for repairing the Conduit Road; for resuming work upon the Washington Aqueduct Tunnel and new reservoir and their accessories; for building a combined storehouse and stable at Great Falls; for purchase or condemnation of a site for a storage yard; for protecting the inlet to the conduit at Great Falls, and for operation, maintenance, and repair of the Washington Aqueduct and its accessories.

Full explanation of these estimates, all of which have my approval, is given in the report of the officer in charge.

The estimates for the fiscal year ending June 30, 1899, are as follows:

For repairing the north connection of the by-conduit, Dalecarlia Reservoir	$3,000.00
For repairing the Conduit Road	5,000.00
For resuming and completing work upon the Washington Aqueduct Tunnel and new reservoir and their accessories	805,850.30
For building combined storehouse and stable at Great Falls	3,000.00
For purchase or condemnation of a site for a storage yard	10,000.00
For protection to the inlet to the conduit at Great Falls	5,000.00
For operation, maintenance, repair, etc., of the Aqueduct and its accessories	21,000.00
Total	852,850.30

WASHINGTON AQUEDUCT, DISTRICT OF COLUMBIA, 1897.

Amount appropriated by act of June 11, 1896	$20,000.00
June 30, 1897, amount expended during fiscal year	19,338.92
July 1, 1897, balance unexpended	661.08
July 1, 1897, outstanding liabilities	618.35
July 1, 1897, balance available	42.73
Amount that can be profitably expended in fiscal year ending June 30, 1899.	*852,850.30

WASHINGTON AQUEDUCT, DISTRICT OF COLUMBIA, 1897.—INSERTING VALVES.

Amount appropriated by act of June 11, 1896	$5,000.00
June 30, 1897, amount expended during fiscal year	4,758.68
July 1, 1897, balance unexpended	241.32

(See Appendix A A A 1.)

2. Increasing the water supply of Washington, D. C.—All operations on this project are suspended. A watchman has been employed during the year at the new reservoir, whose duties include guarding the stone at the mouths of all the shafts except the one at Foundry Branch, which is under the care of the watchman at the distributing reservoir.

Raising the height of the dam at Great Falls.—By act approved March 2, 1895, $125,000 of the balance remaining from the appropriations for "Increasing the water supply of Washington, D. C.," was made available for raising the height of the dam at Great Falls and other works rendered necessary by the raising of the dam and for damages on account of flooding of lands and other damages.

The dam extended from the Virginia to the Maryland shore, crossing

* $805,850.30 of this amount is for resuming work upon the Washington Aqueduct Tunnel and new reservoir and their accessories.

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Conns Island. Its total length was 2,877 feet and its top width 7 feet 9 inches in the Maryland channel and 8 feet 3 inches across Conns Island and in the Virginia channel. The dam was raised 2.5 feet, so that at its low-water stage the river would just fill the mouth of the conduit. Until December, 1895, sandstone was obtained from the United States quarry at Seneca, and was boated down the Chesapeake and Ohio Canal to Great Falls. On January 21, 1896, authority was granted by the Chief of Engineers to obtain stone by contract, and on March 28, 1896, a contract with Mr. Asa B. Cook, of Petersburg, Va., was approved by the Chief of Engineers for furnishing about 1,100 cubic yards of granite dimension stones at $18 per cubic yard and about 100 cubic yards of granite coping stones at $27 per cubic yard. Time of commencement of contract, April 10, 1896; time of completion, July 1, 1896; extended by authority of the Chief of Engineers to September 15, 1896, and further extended to November 15, 1896. Completed November 7, 1896.

The work of laying stone was commenced in October, 1895, and suspended for the winter in November, 1895. Operations were resumed on April 20, 1896, and completed on November 25, 1896. By the use of horizontal movable wooden bulkheads and sand bags and by calking the smaller leaks a cheap and efficient cofferdam was devised, by means of which stone was laid against a head of 4 or 5 feet. Riprap for revetting the upstream side of the dam was obtained from the Government quarry at Seneca, and was boated down the canal.

During the working period there were, excluding only Sundays and national holidays, two hundred and eighty-three working days, eighty-four of which were lost on account of high water in the Potomac River and twenty-three for want of stone from the contractor, leaving one hundred and seventy-six days (including those on which rain fell) available for the completion of all operations connected with work upon the dam itself.

The total length of dam raised was 2,751 linear feet, and in doing this work 1,026 cubic yards of coping was taken up from the crest of the old dam, and 1,669 cubic yards of cut stone, 1,046 cubic yards of coping, 350 cubic yards of concrete, and 5,108 cubic yards of riprap revetment were placed in the new work. In addition, 1,308 5-foot anchor bolts and 1,307 clamps were set in the masonry.

To strengthen the conduit against increased internal pressure the embankments in which the conduit rests were widened in twelve places by the addition of 4,723 cubic yards of earth, making a total of 9,870 cubic yards of materials used for this purpose. Of this amount 5,147 cubic yards was placed during the preceding fiscal year, 3,480 cubic yards of which was charged to the appropriation for preservation, maintenance, and repair of the Washington Aqueduct.

Upon recommendation of the Chief of Engineers, approved by the Secretary of War, an officer of the Corps of Engineers was appointed to meet an engineer selected by the Chesapeake and Ohio Canal Company to form a commission to report upon the probable damage to the company by raising the dam at Great Falls. The two commissioners recommended "that the canal authorities release the United States from all claims for damages to the canal embankment and towpath by reason of raising the dam 2½ feet as authorized by the act of March 2, 1895, and that the United States pay the estimated cost of the protection, $15,000." This recommendation was approved by the Secretary of War, and the officer in charge of the aqueduct notified the general manager of the canal that he was authorized to pay the company $15,000 upon condition that the trustees should execute a paper releasing

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the United States from all claims for damages on account of raising the dam, and should formally authorize in writing an official to receive the sum in question. This was done and the award was paid on February 13, 1897.

A recent inspection shows that since completion the dam has suffered no injury either from ice or freshets.

The work of raising the dam and strengthening the conduit has been completed at a cost considerably below the original estimate, leaving a surplus of $23,627.21.

July 1, 1896, balance unexpended	$72,734.19
June 30, 1897, amount expended during fiscal year	49,106.98
July 1, 1897, balance unexpended	23,627.21

(See Appendix A A A 2.)

IMPROVEMENT AND CARE OF PUBLIC BUILDINGS AND GROUNDS, AND CARE AND MAINTENANCE OF THE WASHINGTON MONUMENT, IN THE DISTRICT OF COLUMBIA.

Officers in charge: Col. (now Brig. Gen.) John M. Wilson, Corps of Engineers, to February 16, 1897, with Lieut. John S. Sewell, Corps of Engineers, under his immediate orders; in the temporary charge of Lieutenant Sewell from February 16 to March 9, 1897; and in the charge of Col. T. A. Bingham, U. S. A., since March 9, 1897.

The Executive Mansion has received the usual care and such repairs and improvements as the funds available would admit. Much repainting has been done to the interior and exterior of the building, and new furniture, carpets, matting, curtains, etc., have been supplied from time to time when necessary. Extensive repairs have been made to the tin roof covering. Repairs of various kinds have been made to the greenhouses connected with the Mansion, and a contract has been entered into for the ironwork and the woodwork required for the repair of the west wing of the conservatory.

Every effort has been made to maintain the Washington Monument and its machinery in good condition, and to continue the improvement and ornamentation of the adjacent grounds.

All boilers and machinery have been carefully overhauled and cleaned, and the work of repainting the ironwork of the interior of the monument has been completed.

The elevator receives the most careful attention, being constantly inspected by experts, and is believed to be as safe as it is in the power of man to make it.

There were 165,595 visitors to the top of the shaft during the year, making a total of 1,409,822 persons who have made the ascent since the monument was opened to the public, October 9, 1888.

The improvement of the monument grounds has been continued; the grading has been completed, and a new gravel roadway, 857 feet long and 30 feet wide, constructed in the northeast part of the grounds.

Extensive improvements have been made to the building, No. 1725 F street NW., occupied by the War Department branch of the Government Printing Office. The old annex has been torn down, a new brick annex constructed, the old main building thoroughly repaired and repainted, and a new steam-heating apparatus introduced.

The house on Tenth street, between E and F streets NW., where Abraham Lincoln died, has been purchased by the United States for the sum of $30,000, as provided in the act of Congress approved June 11, 1896. The sum of $1,000 was also provided in the same act for the repair of the building after purchase, but as it was found that the sum

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of $4,000 would be required to place the building in thorough repair repairs were made to the roof only, at a cost of $173, leaving a balance of $827. No additional repairs will be made pending further action of Congress in connection with this building.

Monthly inspections have been made of the various buildings occupied by the War Department, except the State, War, and Navy building, in connection with their care, repair, and safety.

At the propagating gardens and nurseries extensive repairs were made to the greenhouses; about 500,000 plants were propagated for use in the public parks, shops and storehouses were repaired, and a new greenhouse was constructed.

The asphalt roadways in Judiciary Square and the Executive Mansion grounds, and the asphalt footwalks in Mount Vernon Square, Smithsonian grounds, Lincoln and Stanton parks, and in two of the smaller improved reservations have been extended, and repairs have been made to the asphalt roads in the Executive Mansion grounds and the Smithsonian grounds, and to the walks in Judiciary, Lafayette, Farragut, and Franklin parks and Dupont and Washington circles.

Extensive improvements have been made in Hancock Place, on the north side of Pennsylvania avenue between Seventh and Eighth streets northwest, including the erection of a low ornamental stone wall, with granite entrance steps on the east and south sides of the reservation, and the construction of asphalt walks.

The foundation for the pedestal of the statue of Gen. John A. Logan has been constructed in Iowa Circle.

Much damage was done to the trees and shrubbery in the parks and some damage to the buildings by the severe hurricane which visited Washington on the night of September 29, 1896. The damage to the trees was mainly to the silver poplars, silver maples, and the ash, although the evergreens suffered to a limited extent.

Electric lamps have been installed in Lafayette, Franklin, Judiciary, and Lincoln parks, and the gas lamps in those parks, with some few exceptions, discontinued.

Extensive improvements have been made to the telegraph line connecting the Capitol with the Departments and the Government Printing Office. Fifty-five new chestnut poles, from 50 to 80 feet in length, have been erected, the wires transferred from the old poles, new wire put up where required, and the old poles taken down and removed. The desirability of replacing the present overhead system with underground conduits and cables is submitted for the action of Congress.

Considerable damage was done by a storm in February, 1897, to the iron pile wharf at Bridge Creek landing, Virginia, near Wakefield, the birthplace of Washington. This damage has not been repaired, as there are no funds available for the work.

The officer in charge invites attention to the propriety of erecting a separate building for office purposes for the President of the United States.

He also recommends the extension of the electric-light system to include the Executive Mansion grounds, Monument and Smithsonian parks, the improvement of several reservations, the construction of an asphalt walk on the border of the ellipse south of the Executive Mansion, and necessary legislation for better defined regulations than now exist, for the protection of the national park grounds in the District of Columbia, and for the better security and comfort of the public.

Attention is invited to the detailed report of the officer in charge, and to his estimates and recommendations for the fiscal year ending June 30, 1899.

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His estimates are as follows:

For improvement and care of public buildings and grounds in charge of the Chief of Engineers		$178,271.00
For compensation of persons employed on public buildings and grounds		58,300.00
For repair of existing telegraph lines connecting Capitol and Departments		1,500.00
For contingent and incidental expenses of public buildings and grounds		500.00
For care of Washington Monument and maintenance of elevator:		
Salaries of employees	$9,060.00	
Fuel, lights, contingencies, etc	3,000.00	
		12,060.00
Total		250,631.00

(See Appendix B B B.)

NORTHERN AND NORTHWESTERN LAKES—SURVEYS—CORRECTING ENGRAVED PLATES—PRINTING AND ISSUING OF CHARTS

Local surveys on the Great Lakes by officers of the Corps of Engineers date from the early part of the present century, and the files of this office contain maps made by such officers as far back as the year 1817; from that time up to 1841 the surveys were made only in connection with improvements of various lake harbors and rivers tributary to the lakes, but by that time the needs of navigation had grown so as to demand something much more than the local and disconnected maps resulting from such surveys, and it was recognized that nothing less than a complete charting of the whole lakes and their connecting waterways would meet the requirements of the commerce to which they were destined. The "Survey of the Northern and Northwestern Lakes," as a systematic and connected work, was, therefore, inaugurated by the act of March 3, 1841, which appropriated $15,000 for that purpose. The work was duly assigned to the Corps of Engineers, and its continuation to completion in 1882 was provided for by forty additional appropriations of amounts varying from $10,000 to $175,000, aggregating, with the final appropriation of August 7, 1882, a grand total of $2,939,879. The field work was completed and the Lake Survey office, which had been located in Detroit, Mich., during the whole intervening period, except for a short time after the beginning of the work, when it was at Buffalo, N. Y., was closed in August, 1882, the records of the office being transferred to the office of the Chief of Engineers, U. S. A., in Washington, D. C., where they still remain. The final report of the survey was printed in November, 1882. The total cost of the entire work, including the engraving and printing of all charts, was $2,937,496.68, or $2,382.32 less than the total appropriated, and this surplus was thereupon returned to the United States Treasury. The survey involved a vast amount of astronomical, topographical, and hydrographical work, all of which was executed with the utmost skill and accuracy. The resulting charts were not excelled by any that had been produced by any nation up to that time, and fully supplied the needs of navigation under the conditions then existing.

The work of printing, electrotyping, and issuing charts for the use of navigators and use in connection with lake harbor improvements or other official purposes, has been provided for since 1882 by appropriations aggregating $33,000, and during the same period a total of $11,372.92, derived from the sale of charts, has been turned into the United States Treasury, making the net cost of this service for the past fifteen years $21,627.08.

Up to February 20, 1890, charts were issued free to vessels navigating the Lakes, one set to each registered vessel; additional charts furnished to such vessels, or those furnished to other private parties, being sold at the price of 30 cents each. From the above date the free

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issue, except for official purposes of the Government, was discontinued by Congressional action, and sales were made at a uniform rate of 30 cents each until July 6, 1890, since which time the price has been 20 cents each, except as follows: Lake Superior new (1895) chart, 26⅔ cents; Chicago Lake Front (1892), 25 cents; Buffalo Harbor and Niagara River, 6½ cents; and Erie Harbor and Presque Isle, 10 cents.

Because of the wonderful increase of commerce on the lakes and the greatly increased draft of vessels now engaged in it as a result of recent improvements of harbors and waterways, it has become highly important that areas which have been sufficiently surveyed and charted for the old condition of a 12-foot navigation be resurveyed and recharted. A great deal has already been done in this direction under appropriations made since 1889 "for surveys, additions to and correcting engraved plates," the aggregate of nine successive appropriations for that purpose up to June 30, 1897, being $155,000. This has enabled many localities to be reexamined, and has been especially important as providing the means for a resurvey of the greater part of the St. Marys River; but very much more remains to be done to perfect the general system of charts to the needs of the present conditions of navigation, and it is of the highest importance that it be done as soon as possible. The estimate of $50,000, submitted below, is for this purpose, and it is urgently needed, if the work is to be pushed to a speedy completion.

Operations connected with these additional surveys, correction of plates, and issue of charts during the fiscal year ending June 30, 1897, have been as follows:

Surveys.—The field work for the resurvey of the St. Marys river was completed, including the necessary hydrography and topography, the triangulation between Lake Superior and Straits of Mackinac completed and adjusted; Mackinac base line accurately remeasured; precise levels carried from Charlotte River to Detour, and some current measurements made and magnetic observations taken at several points. In connection with the work a study bearing on the variation in lake levels has been inaugurated.

Dates and amounts of appropriations for survey of Northern and Northwestern Lakes.

March 3, 1841	$15,000	March 2, 1868	$77,500
May 18, 1842	20,000	July 20, 1868	75,000
March 1, 1843	30,000	March 3, 1869	100,000
June 17, 1844	20,000	July 15, 1870	100,000
March 3, 1845	20,000	March 3, 1871	175,000
August 8, 1846	25,000	June 10, 1872	175,000
August 12, 1848	25,000	March 3, 1873	175,000
March 3, 1849	10,000	June 23, 1874	175,000
September 28, 1850	25,000	March 3, 1875	150,000
March 3, 1851	25,000	July 31, 1876 (not including $16,000 applied to survey of Mississippi River)	84,000
August 30, 1852	25,000		
March 3, 1853	50,000		
August 5, 1854	50,000		
March 3, 1855	50,000		
August 30, 1856	50,000		
March 3, 1857	50,000	March 3, 1877 (not including $25,000 applied to survey of Mississippi River and including $9,500 received from sale of steamers)	94,500
June 12, 1858	75,000		
March 3, 1859	75,000		
June 21, 1860	75,000		
March 2, 1861	75,000	June 20, 1878 (not including $49,500 applied to survey of Mississippi River)	49,500
July 5, 1862	105,000		
February 9, 1863	106,879	March 3, 1879	85,000
July 2, 1864	100,000	June 16, 1880	40,000
February 28, 1865	125,000	March 3, 1881	18,000
June 12, 1866	50,000	August 7, 1882	12,000
March 2, 1867	77,500	Total	2,939,879

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PRINTING AND ISSUE OF CHARTS FOR USE OF NAVIGATORS AND ELECTROTYPING COPPERPLATES FOR CHART PRINTING.

March 3, 1883	$3,000	August 5, 1892	$2,000
July 7, 1884	3,000	March 3, 1893	2,000
March 3, 1885	3,000	August 18, 1894	2,000
August 4, 1886	2,000	March 2, 1895	2,000
March 3, 1887	2,000	June 11, 1896	2,000
October 2, 1888	2,000	June 4, 1897	2,000
March 2, 1889	2,000		
August 30, 1890	2,000	Total	33,000
March 3, 1891	2,000		

SURVEYS AND ADDITIONS TO AND CORRECTING ENGRAVED PLATES.

March 2, 1889	$5,000	March 2, 1895	$25,000
August 30, 1890	10,000	June 11, 1896	25,000
March 3, 1891	10,000	June 4, 1897	25,000
August 5, 1892	5,000		
March 3, 1893	25,000	Total	155,000
August 18, 1894	25,000		

Charts.—Under the supervision of this office, and during the fiscal year, additions have been made to the engraved plates of—

Lake Superior, No. 2.
Portage Lake and River, Lake Superior.
River Ste. Marie, No. 1.
River Ste. Marie, No. 2.
Straits of Mackinac.
North end of Lake Michigan.
South end of Lake Michigan.
Beaver Island Group, Lake Michigan.
North end of Green Bay, Lake Michigan.
South end of Green Bay, Lake Michigan.
Coast chart, No. 6, Lake Michigan.
Coast chart, No. 9, Lake Michigan.
Grand and Little Traverse Bays, Lake Michigan.
Lake Huron.
Saginaw Bay, Lake Huron.
Lake St. Clair.
Detroit River.
Lake Erie.
Coast chart, No. 1, Lake Erie.
Coast chart, No. 2, Lake Erie.
Coast chart, No. 3, Lake Erie.
Coast chart, No. 4, Lake Erie.
Coast chart, No. 5, Lake Erie.
Coast chart, No. 6, Lake Erie.
Coast chart, No. 7, Lake Erie.
Sandusky Bay, Lake Erie.
Lake Ontario.
Coast chart, No. 1, Lake Ontario.
Coast chart, No. 4, Lake Ontario.
St. Lawrence River, No. 4.
St. Lawrence River, No. 5.
St. Lawrence River, No. 6.

Chart No. 3, St. Marys River, is finished, but will not be published until the improvements now in progress, and shown on it, are completed. New chart No. 2 is about half finished, and chart No. 1 is in hand. These three charts will all be completed during the coming fiscal year.

The projection of a new chart of Lake Michigan (scale 1 : 400,000) was commenced, and at the close of the year about one-third of the work was completed.

The number of charts sold or issued from the United States Engineer Office at Detroit, Mich., for official use during the year was 4,154. Of these, 4 were sold at 31 cents each, 6 at 30⅔ cents each, 101 at 27 cents each, 245 at 26⅔ cents each, 28 at 25 cents each, 3,402 at 20 cents each, 27 at 10 cents each, 14 at 7 cents each, and 6 at 6½ cents each; 319 were issued for official use. In addition, a number of charts were sold from this office. The total proceeds from sale of charts was $798.62, which was turned into the United States Treasury.

(See Appendix C C C 1.)

Preservation of bench marks along the Erie Canal.—In November, 1895, the attention of this office was called by the superintendent of the New York State land survey to the threatened obliteration of bench marks, by the enlargement of the Erie Canal, which were established by the United States Lake Survey in 1875. Allotments aggregating $387.25 were made from appropriation for "Survey of Northern and Northwestern Lakes," for the purpose of making the necessary exami-

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nation, purchase of instruments, and of establishing bench marks supplementary to the original line. This work was assigned to Maj. W. S. Stanton, Corps of Engineers, and his report thereon will be found in Appendix C C C 2.

Examination of shoals in Lake Erie.—An examination was made in July, 1896, for the unknown rock supposed to be 2 miles ESE. of Starve Island Buoy, on which the steamship *John Oades* stranded, and also for a rock supposed to be eastward of Kellys Island. A very dangerous rock was discovered, located, and buoyed directly in the course of steamers plying between Put-in-Bay and Lakeside. Three other less dangerous rocks were found, and located on the chart. The rock reported east of Kellys Island was not found. This work, costing $750, was assigned to Col. Jared A. Smith, Corps of Engineers, and his report thereon will be found in Appendix C C C 3.

Estimate for the fiscal year ending June 30, 1899.

For printing and issuing charts for use of navigators and electrotyping plates for chart printing	$3,000.00
For surveys and other expenses connected with correcting and extending the charts, including resurvey of St. Marys River, to be available until expended	50,000.00
Total	53,000.00
July 1, 1896, balance unexpended	$29,965.03
Amount appropriated by sundry civil act approved June 4, 1897	25,000.00
	54,965.03
June 30, 1897, amount expended during fiscal year	20,261.09
July 1, 1897, balance unexpended	34,703.94
July 1, 1897, outstanding liabilities	875.50
July 1, 1897, balance available	33,828.44

Annual water levels of the northern and northwestern lakes.—A table showing the monthly means of water levels from July 1, 1896, to June 30, 1897, at Charlotte and Oswego, Lake Ontario; at Erie, Ashtabula, Cleveland, and Monroe, Lake Erie; at Milwaukee, Lake Michigan; at Escanaba, on Green Bay (no observations being made at this latter place from December, 1896, to April, 1897, inclusive); at Sand Beach, Lake Huron, and at Sault Ste. Marie and Marquette, Lake Superior, being in continuation of that published in the Annual Report of the Chief of Engineers for 1896, together with plates, which are continuations of those published in the Report for 1892, will be found in Appendix C C C 4.

MAPS AND PLANS.

Under the supervision of this Office an edition of each of the following maps and plans has been printed and distributed:

Map of the Department of the Columbia.
Map of seat of war in the East—Turkey and parts adjacent.
Illinois and Mississippi Canal. Detailed drawings. Canal around the Lower Rapids. Rock River. In 46 sheets.

RECONNAISSANCES AND EXPLORATIONS.

The following officers have been on duty at the headquarters of the military departments engaged in preparing such maps and making such surveys as were required by their respective commanding officers:

Maj. William L. Marshall, Corps of Engineers, at headquarters Department of the Missouri.

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Lieut. John L. Sehon, Twentieth United States Infantry, until May 8, 1897, after which date Maj. Thomas H. Barry, assistant adjutant-general, at headquarters Department of the Columbia.

Lieut. J. F. Reynolds Landis, First United States Cavalry, until June 14, 1897, after which date Lieut. J. D. Miley, Fifth Artillery, at head quarters Department of California.

Lieut. George T. Langhorne, First United States Cavalry, until May 8, 1897, after which date Lieut. John L. Sehon, Twentieth United States Infantry, at headquarters Department of the Colorado.

Maj. William L. Marshall, Corps of Engineers, engineer officer Department of the Missouri, reports that no field work was done during the year; that office work consisted in preparing section maps of the department, as required and directed by letter dated War Department, Adjutant General's Office, Washington, December 2, 1895; six sheets of the country around Forts Leavenworth and Riley, Kans., and four sheets of the country around Forts Brady and Wayne, Mich., were prepared and issued for revision and completion. In accordance to instructions from the War Department, however, all this work was abandoned and a new system introduced. Maps were prepared for use of department commanders and other officers on duty at department headquarters; maps were mounted, blue prints made, and instruments issued to officers at various posts for use while on duty in the field.

(See Appendix D D D 1.)

Maj. Thomas H. Barry, assistant adjutant-general, United States Army, acting engineer officer, Department of the Columbia, from May 8, 1897, reports that field work consisted of making a survey and setting grade stakes for a quarter-mile race track for athletic purposes, and of minor surveys for improvement of water, sewerage, and drainage systems at Vancouver Barracks; office work consisted of revising map of the department, compiling map showing location of Spokane Falls and Northern Railway from Spokane to the international boundary, making tracings of figures and apparatus for the illustration of cavalry gymnastics, compilation of sheets of "Military Progressive Department Map" and "Progressive Military Map of the United States," under instructions from War Department of December 2, 1895, and April 20, 1897, and in the making and issuing of numerous maps, tracings, and blue prints.

(See Appendix D D D 2.)

Lieut. John D. Miley, Fifth United States Artillery, acting engineer officer Department of California, reports that the energies of the office have been almost exclusively directed to carrying out instructions from the Adjutant-General of the Army of December 1, 1895, and ceased upon receipt of revised instructions dated April 7, 1897; a new index map was prepared; polyconic projection for sheets, in accordance with these instructions, was prepared, but owing to lack of maps showing roads, etc., but little progress has been made. To conform to the act of the California legislature of March 9, 1897, relative to released land to the Federal Government, maps of convenient size were prepared and transmitted to the adjutant-general of the department, of the Presidio of San Francisco, Fort Mason, Alcatraz and Angel islands, Benicia Arsenal and Barracks, and San Diego Barracks. Maps of Sequoia and General Grant National parks and Yosemite National Park have been prepared by Lieutenants Davis and Benson, Fourth United States Cavalry, for use in preparing the sheets of the Military Information Department Map.

(See Appendix D D D 3.)

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Lieut. John L. Sehon, Twentieth United States Infantry, acting engineer officer, Department of the Colorado, reports that excellent work was done on the Progressive Military Map, the section cards returned from the several detachments engaged in the field revision of the same indicating that more satisfactory results will be attained under the system recently adopted than obtained under the method first followed. No map of the department has ever been prepared since its organization with the present territorial limits, and it is proposed to commence a drawing for the production of such a map containing all obtainable information at the first opportunity. Maps of portions of the department have been issued, tracings and solar prints made, maps mounted, and other miscellaneous work done.

(See Appendix D D D 4.)

ESTIMATES FOR AMOUNTS REQUIRED FOR SURVEYS AND RECONNAISSANCES IN MILITARY DEPARTMENTS, AND FOR MAPS, INCLUSIVE OF WAR MAPS.

For military surveys and reconnaissances and surveys of military reservations by the engineer officers attached to the several headquarters of military departments, being an average of $2,142.86 for each of seven military departments west of the Mississippi River, $15,000; for publication of maps for use of the War Department, inclusive of war maps, $10,000; total, $25,000.

Attention is specially invited to this estimate for appropriation and to the important uses for which it is intended.

At the headquarters of the military departments west of the Mississippi River there are stationed officers of the Corps of Engineers, or other officers detailed to act, whose duty it is to make reconnaissances for military purposes, to make such surveys and prepare such maps as may be required by their respective commanding officers. In recent years no appropriations have been made for these purposes, and, consequently, these officers have been very much cramped for lack of the necessary means, and the usefulness of their offices has been very much reduced in consequence. The maps of these departments are constantly in need of revision and additions, which the officers make so far as possible, but with no means, even for the purchase of paper, their efforts are limited in results.

Paragraph 351 of the Army Regulations requires that the commanding officer of each post where there are fixed batteries bearing upon a channel will call upon the Engineer Department for accurate charts showing the soundings to the extent of the ranges of the guns. Calls upon this department to perform its duty under this regulation can not be honored from lack of means.

Interest in the war maps published by this office and republished by virtue of the sundry civil act of March 2, 1889, continues very active. Of the 1,100 copies of each map printed under the act alluded to, all those not printed in this office (47 sheets) have been exhausted for some time, and the calls for them can only be honored with sets deficient in that number of sheets.

Besides all this, there is much information in this office relative to military geography which could with little expense be made available for the information of officers of the Army; for instance, there are on the office files detailed maps of regions of Europe which may become at an early day the theaters of war, and it would be of great advantage to the service if such information as these maps give could be made

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available for the study of officers, especially on the outbreak of hostilities. Were the means provided, this office would be glad to compile and to disseminate the information on its files.

It is the policy of this country to keep a standing army small in numbers, but it is its expectation that it should be a highly instructed one, and a small outlay as here referred to will be conducive to that end.

Applications from officers of the Army have been received for maps of certain regions of Europe, and it was with great regret that this office could not render this assistance to officers desirous of improving themselves professionally, especially when the material was on its files.

OFFICE OF THE CHIEF OF ENGINEERS.

During the fiscal year ending June 30, 1897, the following-named officers were on duty in this office as assistants:

Lieut. Col. Alexander Mackenzie,
Capt. William M. Black, until March 2, 1897,
Capt. George W. Goethals,
Capt. Joseph E. Kuhn, since August 1, 1896,
First Lieut. Chester Harding, until August 18, 1896, and
First Lieut. John S. Sewell, from March 16 to April 1, 1897.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

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APPENDIXES

TO THE

REPORT OF THE CHIEF OF ENGINEERS,

UNITED STATES ARMY.

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APPENDIXES

TO THE

REPORT OF THE CHIEF OF ENGINEERS,

UNITED STATES ARMY.

FORTIFICATIONS, ETC.

APPENDIX No. 1.

REPORT OF THE BOARD OF ENGINEERS.

THE BOARD OF ENGINEERS, ARMY BUILDING,
New York City, July 6, 1897.

GENERAL: I have the honor to submit the annual report recounting the operations of The Board of Engineers for the year ending June 30, 1897.

The following changes in the personnel of the Board have taken place since the date of the last annual report:

Under date of July 15, 1896, Maj. Charles W. Raymond, Corps of Engineers, was relieved, and Maj. Henry M. Adams, Corps of Engineers, was detailed as a member of The Board of Engineers.

As at present constituted, The Board of Engineers consists of the following-named officers of the Corps of Engineers: Col. Henry M. Robert, president, Col. G. L. Gillespie, Maj. Henry M. Adams, Maj. John G. D. Knight, and Capt. H. F. Hodges.

In addition, the division engineers are members of the Board when matters pertaining to defensive works in their respective divisions are under consideration.

The Board has considered the various subjects referred to it during the past year by the Chief of Engineers, and the following is a brief summary of the reports rendered thereon:

1896.

July 9. On emplacements for 10-inch high-power guns mounted on disappearing carriages, model 1896.

July 9. On request of Capt. T. L. Casey, Corps of Engineers, for plans for mortar beds and platforms.

July 16. On dimensions in plans for emplacements for 10-inch high-power guns having reference to those now in process of construction on Delaware River.

July 17. On the proposed regulation of seacoast artillery fire.

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1896.
July 24. On plans and estimates for ammunition hoist for 12-inch rifle, submitted by First Lieut. C. L. Potter, Corps of Engineers, and forwarded by Maj. C. E. L. B. Davis, Corps of Engineers.
July 24. On ammunition conveyors and cranes for batteries for 8-inch and 10-inch guns mounted on disappearing carriages, and for the 12-inch barbette guns, San Francisco, Cal.
July 24. On revised typical mortar battery.
July 24. On machine guns required for fortifications and mounts for the same.
Aug. 14. On platform for 12-inch steel mortar mounted on the United States disappearing carriage, model 1896.
Aug. 14. On platform for 10-inch B. L. R. mounted on the United States disappearing carriage, model 1896.
Aug. 14. On the general subject of ammunition delivery in modern batteries.
Aug. 14. On emplacement for 12-inch B. L. R. mounted on the United States disappearing carriage, model 1896.
Aug. 22. On platform for 12-inch B. L. R. mounted on the United States disappearing carriage, model 1896.
Sept. 10. On suggestion from the Chief of Ordnance of September 2, 1896, relative to the arrangement of a manhole for access to well cylinder of disappearing gun carriages.
Sept. 10. On retention of Government reservation in Baldwin County, Ala., for military purposes.
Sept. 10. On data necessary to enable the Board to prepare a platform drawing for 10-inch disappearing carriage, all-round fire.
Sept. 11. On the subject of what distance from the center of the well the moment of stability of the platform, gun, and mount of the 12-inch B. L. R. is about five times the overturning moment.
Sept. 15. On the calculations employed by The Board of Engineers in determining the overturning moment and the moment of stability of the platform for the 10-inch rifle on disappearing carriage, model 1896.
Sept. 18. On letter from Col. Peter C. Hains, Corps of Engineers, September 14, 1896, relative to shortening the crank arms for ammunition cranes.
Oct. 1. On the limit of time which should elapse after the completion of the concrete portion of gun and mortar platforms before firing should be permitted from them.
Oct. 6. On the subject of the construction of a type 6-inch rapid-fire gun, and on the adoption of the 6-inch rapid-fire gun in addition to the 5-inch rapid-fire gun as part of the system of coast defense.
Oct. 9. On the subject of electric lighting for batteries at Hampton Roads, Va.
Oct. 9. On revised project of Col. P. C. Hains, Corps of Engineers, for the artillery defense of Baltimore, Md.
Oct. 21. On project for manhole for access to the counterweight well of emplacements for the Buffington-Crozier disappearing carriages, model 1894.
Oct. 21. On modification of Board's plan of February 20, 1896, for typical emplacement for 8-inch high-power gun.
Oct. 28. On request of Capt. F. V. Abbot, Corps of Engineers, for authorative list of present approved project for armament of forts in Charleston Harbor, and detailed drawings of platforms suitable to the last designs of carriages for 15-inch smooth-bore guns and 8-inch converted rifles mounted en barbette.
Oct. 28. On distribution of about seventy 8-inch converted rifles now on hand by Ordnance Department.
Oct. 30. On the utility of certain works now forming part of the defense of New Orleans and the mouth of the Mississippi River.
Nov. 11. On the artillery defense of New Bedford, Mass.
Nov. 27. On the submarine defense of New Bedford, Mass.
Nov. 27. On letter from the Chief of Ordnance dated November 10, 1896, relative to alterations in certain carriages originally intended for the gun-lift into barbette carriages.
Dec. 10. On the disposition of 8-inch converted rifles.
Dec. 23. On plant required for the electric lighting of fortifications, with an estimate of cost of the various kinds of electrical material, etc., recommended.
Dec. 31. On platform for 8-inch B. L. R. mounted on the United States disappearing carriage, model 1896.
Dec. 31. On emplacements for 8-inch B. L. R. mounted on the United States disappearing carriage, model 1896.
Dec. 31. On letter from the Chief of Engineers of December 18, 1896, with reference to clearance for the traversing gear handles for the 8-inch disappearing carriage, model 1896.
Dec. 31. On ammunition crane proposed for the emplacements for 10-inch guns on Delaware River.

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1897.

Jan. 2.
Jan. 12.
Jan. 20. } On the distribution of the proposed 6-inch rapid-fire guns for the defense of New York Harbor.

Jan. 12. On drawing of ammunition crane intended to replace that sent with the report of the Board of June 1, 1896.

Jan. 12. On nomenclature adopted for the parts of emplacements for modern high-power guns.

Jan. 12. On letter from the Chief of Engineers of January 7, 1897, relative to the adoption of a 12-pounder rapid-fire gun for the defense of mine fields.

Jan. 12. On the relocation of 8-inch converted rifles at Fort Point, California.

Jan. 12. On the importance of St. Andrews Bay, Florida, for defensive purposes.

Jan. 18. On the requirements of the Engineer Department with reference to the proposed 6-inch rapid-fire guns for coast defense.

Jan. 18. On the recommendations of the Board of Ordnance and Fortification in relation to the equipment in New York Harbor of an experimental fire-control station.

Jan. 26. On H. R. 10080, Fifty-fourth Congress, second session, being a "bill for appointment of a commission to report on Romer Shoals, harbor of New York, as a suitable site for erection of fortification and seacoast defense."

Jan. 26. On design for platform for 12-inch breech-loading rifle mounted en barbette on altered gun-lift carriage.

Jan. 26. On ammunition crane designed by Lieut. Col. D. P. Heap, Corps of Engineers.

Jan. 26. On letter from the Chief of Engineers of January 2, 1897, directing the Board to consider and recommend such repairs and transfers of armament as may be needful to insure efficient aid from the old works.

Jan. 26. On letter from the Chief of Engineers of January 16, 1897, requesting the Board to report what modification of the platform or of the method for determining the elevation of the gun can be adopted in order to comply with certain requirements of the Ordnance Department.

Feb. 2. On distribution of rapid-fire and old armament for defense of Baltimore, Md.

Feb. 2. On retention of reservations in Florida for defensive purposes.

Feb. 4. On adoption of the Maxim machine gun for defensive purposes.

Feb. 4. On ammunition lift for 10-inch B. L. R.

Feb. 12. On emplacement for 5-inch rapid-fire gun.

Mar. 20. Relative to the submarine mine defense of Baltimore, Md.

Mar. 24. On distribution of rapid-fire guns and old armament for Boston Harbor.

Mar. 29. On distribution of rapid-fire guns and old armament for the Delaware River.

Mar. 30. Reply to letter of the Chief of Engineers of March 27, 1897, relative to armament for the defense of New Orleans, having special reference to allotment for 10-inch guns.

Apr. 14. Relative to changes proposed by the Ordnance Department in the 12-inch disappearing carriage, L.F., model 1896.

Apr. 14. On emplacements for 5-inch rapid-fire guns.

Apr. 15. Relative to modification in the surface of the platforms for the disappearing carriage, model 1896.

Apr. 21. On revised project for the submarine mine defense of Baltimore Harbor, Maryland.

Apr. 21. On platform for 12-inch mortar carriage, model 1896. (Revised.)

Apr. 21. On distribution of rapid-fire guns and old armament for defense of Baltimore Harbor, Maryland.

Apr. 23. On indorsement of the Chief of Engineers of March 16, 1897, referring request from Capt. W. L. Fisk, Corp of Engineers, relative to rapid-fire armament for Columbia River, Washington.

Apr. 23. On distribution of rapid-fire guns and old armament for defense of the Columbia River.

Apr. 28. On locations for three 5-inch or 6-inch rapid-fire guns in eastern entrance to New York Harbor, proposed by Maj. H. M. Adams, Corps of Engineers.

Apr. 28. On locations for two rapid-fire guns in eastern entrance to New York Harbor, proposed by Maj. H. M. Adams, Corps of Engineers.

Apr. 28. On distribution of rapid-fire guns and old armament for defense of New Bedford, Mass.

Apr. 28. On distribution of rapid-fire guns and old armament for defense of Narragansett Bay, Rhode Island.

May 5. Relative to changes in the project for the artillery defense of Narragansett Bay, Rhode Island.

May 5. On revised platform for 12-inch mortar carriage.

May 8. On platform for 12-inch disappearing carriage, L.F., model 1897.

May 8. On certain changes suggested in constructions intended to mount the 12-inch disappearing carriage, L.F., model 1897.

May 19. On proposed armament for defense of New Orleans.

May 21. On observing stations for emplacements for high-power guns.

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1897.
May 21. On platform for 5-inch rapid-fire gun en barbette on balanced-pillar mount.
May 21. On artillery defense of the entrance to Lake Champlain.
May 21. On submarine defense of the entrance to Lake Champlain.
May 21. On artillery defense of the Kennebec River, Maine.
May 21. On submarine defense of the Kennebec River, Maine.
May 26. On distribution of rapid-fire guns and old armament for defense of Portland, Me.
June 1. On the desirability of the further use of dynamite guns for coast defense.
June 11. On changes in platform construction, disappearing carriages.
June 16. On the artillery defense of the Penobscot River, Maine.
June 16. On the submarine defense of the Penobscot River, Maine.
June 16. On the subject of parallel and independent fire for mortar batteries.
June 23. On the application of Maj. J. B. Quinn, Corps of Engineers, for postponement in preparation of his plans for additional gun battery at New Orleans, La.
June 23. On project for construction of Lock and Dam No. 1, Osage River, submitted by Capt. H. M. Chittenden, Corps of Engineers.
June 28. On distribution of rapid-fire guns and old armament for Pensacola, Fla.
June 29. On letter from Col. P. C. Hains, Corps of Engineers, Division Engineer of the Southeast Division, in regard to the grouping into batteries of certain guns for defense of Hampton Roads, Va.
June 29. On the artillery defense of New Orleans, La.

In the performance of its duties, the Board, under instructions from the Chief of Engineers dated October 28, 1896, made a personal inspection of sites for the defense of New Orleans, La., and the mouth of the Mississippi River on November 15 and 16, 1896.

In addition to their duties with The Board of Engineers, the individual members of the Board have been engaged as follows during the year ending June 30, 1897:

Col. Henry M. Robert, the president of The Board of Engineers, served as division engineer of the Northwest Division until May 7, 1897, when he was relieved and assigned as division engineer of the Southwest Division, upon which duty he now continues. He served as a member of a Board of Engineer Officers to consider and report on a project for a dike between Reedy Island and Liston Point, Delaware River, and is ex officio a member of the Board of Visitors to the United States Engineer School. He also served and continues at present on the following boards: On harbor lines for New York Harbor and vicinity; on harbor lines for Philadelphia; on Board to reconsider project for the improvement of Pensacola Harbor, Florida; on Board for the examination of officers of the Corps of Engineers with a view to their promotion; on Board to examine and report on a water route from the mouth of the jetties at Galveston, through the ship channel and up Buffalo Bayou, to Houston, Tex., and as president and disbursing officer of a Board to ascertain the character and value of improvements at the mouth of the Brazos River, Texas.

Col. G. L. Gillespie, Corps of Engineers, was relieved from charge of river and harbor work and defenses February 12, 1897, and was assigned to duty as division engineer of the Northeast Division from February 11, 1897. He has continued to serve as member and president of the Mississippi River Commission; as a member of the Board of Visitors to the United States Engineer School; as a member of Boards of Engineer Officers to report upon harbor lines of New York Harbor and adjacent waters; to reconsider the project for improvement of Pensacola Harbor, Florida, and as member of a Board of Engineer Officers for the examination for promotion of officers of the Corps of Engineers. He has also served as a member of Board of Officers to report on certain projects of fortification defenses, and to report upon the filling in of Belle Isle Inlet, Boston Harbor, and was appointed to

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investigate the propriety of authorizing the construction of an electric railway across the Government reservation at Fort McClary. He has been a member of the Light-House Board since April 16, 1897.

Maj. Henry M. Adams, Corps of Engineers, has conducted the various works of river and harbor improvements and of fortifications under his charge during the past fiscal year, and has served as a member of the following boards: On Board of Engineer Officers on harbor lines for the Detroit River; on Board of Officers on sites for range stations and auxiliary objects, and on Board to select a site for a hospital at Fort Wadsworth, N. Y. He is a member of the Board of Visitors to the United States Engineer School; of the Board on Harbor Lines for the harbor of New York and its adjacent waters, and of a Board of Engineer Officers for the revision of the existing torpedo system.

Maj. John G. D. Knight, Corps of Engineers, commands the United States Engineer School, the Battalion of Engineers, and the post at Willets Point, N. Y., and is a member of the Board of Officers for the examination for promotion of certain officers of the Corps of Engineers and of the Board of Officers for the consideration of the existing torpedo system. During the past fiscal year he was in charge of the defensive works at Fort Schuyler and Willets Point; of the construction of gun and mortar batteries for the defense of New York at the eastern entrance of the harbor and of the sea wall at Fort Slocum, N. Y., until July 21, 1896, and was a member of the Board of Officers to test range and position finders until June 25, 1897.

Capt. H. F. Hodges, Corps of Engineers, has continued as disbursing officer of the Corps of Engineers in addition to his other duties. He served as a member of the Board of Visitors to the United States Engineer School, and, under instructions from the Chief of Engineers, made an inspection of certain material for coast defenses at the foundry of Fried. Krupp Grusonwerk at Magdeburg-Buckau, Germany.

For the Board:

Very respectfully, your obedient servant,

HENRY M. ROBERT,
Colonel, Corps of Engineers, President of the Board.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

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APPENDIX No. 2.

POST OF WILLETS POINT, NEW YORK—UNITED STATES ENGINEER SCHOOL—BATTALION OF ENGINEERS—ENGINEER DEPOT.

REPORT OF MAJ. JOHN G. D. KNIGHT, CORPS OF ENGINEERS, FOR THE FISCAL YEAR ENDING JUNE 30, 1897.

UNITED STATES ENGINEER SCHOOL,
Post of Willets Point, New York Harbor, July 17, 1897.

GENERAL: I have the honor to forward herewith in duplicate my annual report on the post at Willets Point, New York Harbor; the United States Engineer School; the Battalion of Engineers, and the Engineer Depot, for the fiscal year ending June 30, 1897.

Very respectfully, your obedient servant,

JOHN G. D. KNIGHT,
Major, Corps of Engineers, Commanding.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

I.—POST OF WILLETS POINT, N. Y.

The garrison of the post during the year has consisted of headquarters, band, Companies A, B, and C, Battalion of Engineers, and a detachment of ten enlisted men of the Hospital Corps.

Total authorized enlisted strength, 413.

Two brick buildings have been erected—a garbage crematory, commenced June and completed September, 1896, cost $1,900, and a quartermaster and commissary storehouse, commenced September, 1896, completed January, 1897, cost, $9,212.

A brick bakehouse, to cost $3,494, was commenced June, 1897.

A condemned frame tin shop (No. 27) was torn down.

The system of water pipes has been extended, to afford greater protection of engineer stables and storage buildings and the ice house against fire. Much repair of roads with material purchased in the preceding fiscal year has been effected, and quite recently a 5-ton horse road roller has been received.

Allotments for labor and materials used in repairs and additions, etc., have been received as follows:

Barracks and quarters	$3,403.39
Hospital buildings	221.90
Heating apparatus	1,633.84
Plumbing and teamsters	3,112.37
Water pipe and 2 hydrants	474.77
Post wharf	155.94
Labor	2,100.00
Total	11,102.21

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New company mess buildings and band barracks are urgently needed. The acting inspector-general, North Atlantic district, Maj. H. C. Hasbrouck, Fourth Artillery, reported as to this need October 24, 1896, as follows:

The consolidated post mess is established in an old, unsightly, and inconvenient wooden building. It is much out of repair and is not worth the expenditure of any funds to put it in better condition. It is so flimsy and full of cracks that it can not be comfortably heated in cold weather. Its dilapidated condition was mentioned in the last annual inspection report of the post. A new building to accommodate three separate company messes is needed.

The band barracks are old, out of repair, and uncomfortable. They are not worth repairing and ought to be replaced by a new building.

The inspector-general, North Atlantic district, Col. R. P. Hughes, informed me by letter dated July 10, 1897, that—

The first requisite of your post, in my opinion, is suitable messing arrangements for the companies. I do not use the word building, for, as your company organizations, by reason of the specialty of the Corps, are not apt to serve together in the field, it would seem to be specially advisable that each company should be constantly in full state of preparation to take care of and prepare its own rations.

The next urgent need, and it is quite urgent, is the proper accommodations for the men now serving in the band. The shed they are now in is utterly unsuitable.

The following are extracts from my annual report for the fiscal year ending June 30, 1896:

A new mess hall is urgently needed. The present is a frame structure built about twenty-six years ago. The woodwork, including window frames, is in such condition that the building can not be heated to a comfortable temperature. An estimate was submitted last spring for additional heating facilities, but was disapproved, on the ground that the building was too old to justify their installment. So the old hall is not allowed to be suitably heated, nor is a new hall authorized. A new building should be provided without delay, and should be so planned as to allow of the three companies having separate messes. The mess conditions in time of peace should be analogous to those in time of war.

The training in the combined mess kitchen is not the training best suited for the service when companies are independent of one another for subsistence purposes.

Four sets of frame quarters for married enlisted men are now vacant and will be eventually made part of adjacent sets.

The post schools for the enlisted men and for the children living on the post were under the supervision of Second Lieut. W. B. Ladue, Corps of Engineers. Twenty-nine enlisted men and 54 children have received instruction. One child received diploma certifying to its having completed the prescribed course of study.

In accordance with the instructions of the Secretary of War, communicated to the commanding general, Department of the East, by letter from the headquarters of the Army, dated December 14, 1896, the modern defenses and armament at this fort were turned over to the commanding officer of the artillery garrison at Fort Schuyler for all requisite oversight and preservation, excepting the policing and other care of slopes and grounds with which the garrison of the post of Willets Point is charged.

The care and oversight of armament is exercised by details from the Fort Schuyler garrison, which, while actually in the modern batteries and caring for them and their armament, are independent of the commanding officer at Willets Point; but while at the post, going to or returning from the batteries, or elsewhere than at the batteries, they are required to comply with the post regulations, which, however, must not be such as to hinder them in the proper performance of their duties.

June 1, 1897, two batteries, B and C, Fifth Artillery, came to the post for artillery practice, under orders from the commanding general, Department of the East.

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They went into a camp designated by the post commander. Water was piped to the body of the camp and to the field kitchen. Mess tents, material for tables and benches, and part of their rations were supplied.

Their occupation of part of the post, of which the Chief of Engineers was informed June 2, 1897, was sanctioned June 3, 1897, by a letter of the War Department to the commanding general, Department of the East, which authorized that officer to send artillery troops, not to exceed two batteries at a time, during June and July, this year, to camp here for drill, instruction, and practice with modern guns. By this letter the Secretary of War directed that the troops ordered on this service be subject, while at Willets Point, to the regulations prescribed for the government of the post, and further modified the letter of December 14, 1896, in accordance with the above.

These batteries remained at the post until June 22, 1897, and Battery H arrived June 24 and left June 29. They did not share in the guard or police duty of the post, and were subject only to such restrictions as to leaving the post as the senior artillery officer chose to enforce. Their morning reports were rendered to the adjutant, and their officers constituted the summary court when they were senior in rank relatively to other officers commanding the battalion of engineers or on duty with engineer companies.

During the stay of these batteries the command of the post was exercised by the senior engineer or artillery officer present.

Battery M arrived July 1, and its commanding officer declined to recognize the post commander as his commanding officer while in camp here. The position taken was at once communicated to the Chief of Engineers, and July 7, 1897, by direction of the President, the post commander, by name, was assigned to the command of the artillery while at this post during the present season. But Battery M, the last battery to practice here this season, had left July 3.

Article of war 122 reads:

> If, upon marches, guards, or in quarters, different corps of the Army happen to join or do duty together, the officer highest in rank of the line of the Army, Marine Corps, or militia, by commission, there on duty or in quarters, shall command the whole and give orders for what is needful to the service, unless otherwise specially directed by the President, according to the nature of the case.

Certainly the regular garrison and the batteries camped here in the months of June and July did duty together, and the captains commanding two of these batteries considered that the instructions of the Secretary of War above quoted conferred the right to command upon the senior officer present attached to battalion or battery, and that officer did command. But the officer commanding the battery last to arrive did not thus construe these instructions, and in consequence the order of the President was issued.

No command was exercised under it, because it was received after the departure of the last battery. Had it been received in time to be enforced, either the officer designated in the order would have been obliged to remain continuously on the post, or else, in his absence, the officer commanding the battery would have been in command of the post, notwithstanding there were two officers present, commanding companies of engineer troops, of higher rank.

Paragraph 17, Army Regulations, directs that certain officers, among them officers of engineers, shall not assume command of troops unless put on duty under orders which specially so direct by authority of the President.

So far as it relates to engineer officers, this paragraph is the outcome

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indirectly of a dispute which occurred in 1802, forty-four years prior to the organization of the present Company A of the Battalion of Engineers and fifty-nine years prior to the organization of three more companies which, with Company A, constituted the Battalion of Engineers.

This battalion, while instructed in its technical duties, is armed, equipped, and drilled as infantry. As infantry, in 1869 and 1870 it assisted in enforcing laws in Brooklyn, in 1870 in New York City, and in 1877 in Pennsylvania. Since 1891 it has annually taken part in the Memorial Day parade in New York City; and as for its participations in other parades, reference may be had to its record for this fiscal year—at Brooklyn, July 4, 1896; at Washington, March 3–5, 1897; at New York City, April 27, 1897; at Philadelphia, May 15, 1897. All the guard duty performed at the United States Military Academy, other than by mounted patrols, is done by engineer soldiers.

The officers attached to the companies of the battalion have all received the best of military educations and are qualified to command troops. But because of a dispute which occurred almost half a century before the existence of engineer troops the officers attached to these troops can command no others except when specially so directed by authority of the President.

Paragraph 17, Army Regulations, should not apply to officers of engineers on duty with engineer troops armed, equipped, and drilled as infantry. Engineer troops thus armed, equipped, and drilled should, with the engineer officers attached to them, be deemed part of the line.

Besides the officers of the Corps of Engineers on duty with the troops the following have been stationed at the post during the year:

Maj. H. S. Turrill, surgeon, joined October 12, 1896.
Maj. E. A. Koerper, surgeon, relieved October 12, 1896.
Capt. J. D. Poindexter, assistant surgeon, joined November 4, 1896.
Capt. N. S. Jarvis, assistant surgeon, relieved May 4, 1897.

Detailed for instruction in submarine mining at the United States Engineer School, paragraph 346, Army Regulations:

First Lieut. Wilson Chase, Twenty-second Infantry, relieved October 31, 1896.
Second Lieut. M. A. Batson, Ninth Cavalry, relieved October 31, 1896.
Second Lieut. W. D. Davis, Seventeenth Infantry, relieved October 31, 1896.
Second Lieut. G. H. McMaster, Twenty-fifth Infantry, relieved October 31, 1896.
Second Lieut. C. G. Sawtelle, jr., Second Cavalry, relieved October 31, 1896.
Second Lieut. W. H. Mullay, Twenty-first Infantry, relieved October 31, 1896.
Second Lieut. W. T. Johnston, Tenth Cavalry, joined December 5, 1896.
Second Lieut. F. A. Wilcox, First Infantry, joined December 1, 1896.
Second Lieut. W. C. Rogers, Seventh Infantry, joined December 10, 1896.
Second Lieut. F. B. McKenna, Fifteenth Infantry, joined December 1, 1896.
Second Lieut. W. A. Raibourn, Fourth Infantry, joined December 1, 1896.

II.—UNITED STATES ENGINEER SCHOOL.

COMMANDANT.

Maj. John G. D. Knight, Corps of Engineers.

The school year is divided into two seasons: The winter season, extending from December 1 to May 31, and devoted chiefly to theoretical instruction; the summer, extending from June 1 to November 30, and devoted chiefly to practical work. But the present and future summer courses will terminate October 31 and winter courses April 30.

Under paragraph 346, Army Regulations, as amended by General Order No. 33, War Department, Adjutant-General's Office, May 28, 1897, the course of instruction in submarine mining, of cavalry, artillery, and infantry officers, commences on the 1st day of November and ends on the 1st day of September following.

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For purposes of instruction the school is divided into five departments—

I. Military engineering.
II. Submarine mining.
III. Civil engineering.
IV. Practical astronomy.
V. Military photography.

I.—Military Engineering.

Instructors: Capt. Theodore A. Bingham, Corps of Engineers, from July 1, 1896, to March 8, 1897; the commanding officer, from March 8, 1897, to May 21, 1897; Capt. Graham D. Fitch, Corps of Engineers, from May 21, 1897, to June 30, 1897.

Early in January the officers of the third winter's class began the eight weeks' course in this department. Prescribed text-books were studied and oral examinations held weekly. Theses were prepared by the student officers upon the Peninsular and Gettysburg campaigns.

Subjects of study.—Modern seacoast defenses; minor tactics and strategy; logistics; army organization; war game; problems; laws affecting relations between civil and military authorities.

II.—Submarine Mining.

Instructor: Capt. William C. Langfitt, Corps of Engineers.

During July and August practice in loading and planting submarine mines occupied the cavalry and infantry officers detailed here for instruction, the necessary assistance being rendered by enlisted men.

During January and a part of February the companies of engineers were in turn given instruction in the loading-room drill until all available men were considered proficient. This instruction was supervised by the instructor in submarine mining, the lieutenants of the different companies being in immediate charge.

From December 1 to May 31 the officers of the first year's class and the detail of cavalry and infantry officers were continuously engaged in practical laboratory work, making electrical tests and measurements.

During June the cavalry and infantry officers have had practical experience in the various duties of submarine mining, their work being in connection with the instruction of enlisted men in this service.

III.—Civil Engineering.

Instructor: Capt. S. W. Roessler, Corps of Engineers.

During October the officers of the second year's class completed a hydrographic survey of a portion of Little Neck Bay, gauging the tidal flow.

In May the officers of the first and third winters' classes completed courses of three and eleven weeks respectively in this department. As regards the more advanced work of the third winter's class, the method of instruction pursued was as described in the last annual report.

Subjects of special study have been cements and cement testing; foundations; boilers and engines; movable dams; breakwaters, especially the Buffalo Breakwater; improvement of tidal estuaries; the mouth of the St. Johns River, Fla.; preparation of specifications for cements and concrete plants; report upon a hypothetical survey for an inland water route.

The three weeks' course pursued by the first year's class included the following subjects: Use of transit and levels in topographical surveying; hydrographic surveys and gauging of streams; geodetic and railroad surveying.

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IV.—Practical Astronomy.

Instructors: The commanding officer from July 1, 1896, to May 21, 1897; First Lieut. W. V. Judson, Corps of Engineers, from May 21, 1897, to June 30, 1897.

The practice had by each officer of the second year's class was as follows:

The computation of the places of all stars observed in connection with the problems to be solved, the determination of the constants of the instruments employed, establishing all electrical circuits used to connect stations and at each station; sets of time observations taken with the transit on two consecutive nights and determining therefrom the error of the chronometer used, and observations for latitude with the zenith telescope on five nights.

The officers jointly determined the difference of longitude of the observatory and a field observatory located on the post. All computations were made by the observers.

The methods outlined in Chauvenet's Astronomy were closely followed; Safford's Catalogue of Declination of Stars for January 1, 1875, and the American Ephemeris and Nautical Almanac were used.

Full records of the work performed and of the results obtained have been made and will be preserved, especially for comparison with that which may be done by future classes.

The labor involved by the practice above outlined may be better appreciated when it is known that it was executed, as usual, without release of the officer from his other duties.

V.—Military Photography.

Instructor: First Lieut. E. W. Van C. Lucas, Corps of Engineers.

The two officers of the first year's class took the required course as time availed between October 1 and December 1, 1896.

There has also been constant instruction of noncommissioned officers, one course being by roster; and a second, more advanced, confined to specially proficient men.

First Lieut. Wilson Chase, Twenty-second Infantry, and Second Lieut. W. D. Davis, Seventeenth Infantry, in addition to their course in submarine mining, also took a practical course in astronomy and photography.

The programmes of study and instruction for the summer of 1896, the winter of 1896–97, and the summer of 1897 are given in the following orders:

Programme of Study and Instruction for Summer Season.

[Printed Orders, No. 26.]

United States Engineer School,
Willets Point, N. Y., May 26, 1896.

The following programme of study and instruction for the ensuing summer season, commencing June 1 and ending November 30, 1896, having been approved by the Chief of Engineers, is published for the information and guidance of all concerned:

I.—Submarine Mining.

1. After receiving such preliminary practice as may be necessary to acquaint them with the practical details, the officers of the class in submarine mining will be detailed for the purpose of taking charge of preparing and planting mines.

2. Officers so detailed will report to company commanders for the duty above stated. Daily journals of operations will be kept. Officers will frequently interchange duties, so that each may have experience in each part of the drill.

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3. When relieved, each officer of the class in submarine mining will submit to the instructor, through the company commander, a report of the work done by him, mentioning difficulties encountered and any suggestions he may desire to make.
4. Hours of work will be those designated for fatigue duty.
5. Occasionally, loaded mines will be planted and fired as in actual service, height of jet, effect on neighboring mines, and other phenomena being carefully observed and recorded.
6. The electric light will be set up and operated.
7. When the mines are taken up, the parts are to be dismantled, cleaned, and conveniently grouped, after which they will be inspected.
8. A detailed record will be kept of what each enlisted man does, with the view of tracing out the author of defective work and determining the degree of proficiency developed. An account of the character of work done by each man will be submitted by the company commander at the close of the work of his company.
9. Officers of the class in submarine mining will make practical experiments in calibrating commercial ammeters and voltmeters, testing efficiency of dynamos and motors, and execute other work under the supervision of the instructor.

II.—Civil Engineering.

10. A topographical survey of about one-half square mile of ground will be made by each officer of the first year's class. Time allotted, five weeks.
11. A hydrographic survey of about one-quarter square mile, including discharge measurements, by each officer of the second year's class. Time allotted, four weeks.

III.—Practical Astronomy.

12. Lieutenants of Engineers who have not already completed the course will constitute the observers.
13. The following will be the ordinary routine of observations with the several instruments after reasonable proficiency has been attained by preliminary practice:

SEXTANT.

After becoming skillful in the use of this instrument upon the sun, observers will deduce at least one satisfactory latitude by observing a north and a south star, using the time deduced from an east and a west star—each based on ten altitudes taken on the same night. These observations for latitude and time must be made at the observatory. The observer may get "time" from an assistant using a portable chronometer, and will determine by comparison the error of the standard chronometer at the observatory.

CHRONOGRAPH.

Daily determination by time signal from Washington, D. C., of error and rate of astronomical clock.

TRANSIT.

A satisfactory set of time observations will be taken by each officer on two nights, successively if possible, determining satisfactorily the error of the sidereal clock. The first year's class will employ the eye and ear method; the second year's class will use the chronograph.
Difference of longitude will be determined by the use of the telegraph.

ZENITH TELESCOPE.

Observers will first determine the level correction by daylight, using a distant terrestrial object, or at night by using a slow circumpolar star. They will then find the value of a turn of the micrometer by observing Polaris at elongation. Lastly, they will observe for latitude until they have obtained a satisfactory determination.

THEODOLITE.

Determination of azimuth.
14. Problems will be submitted upon suitable blank forms, complete in every detail, before November 30, 1896.
15. Hours of attendance at the observatory will be regulated by the instructor.

IV.—Military Photography.

16. The laboratory, apparatus, etc., will be under the charge of the battalion quartermaster, who will submit to this office weekly reports showing the nature of the instruction given, the results attained, and the progress made.

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17. The course will be for officers of the first year's class. Time allotted, five weeks.

18. Other officers are invited to avail themselves of the advantages of the laboratory, making such arrangements with the officer in charge as shall insure no confusion in his official duties, or in those of the men under his instruction.

19. Practice will be had in the following methods: Negatives by dry process; developers and intensifiers; silver printing, and finishing and mounting of prints; map printing by the blue process and on bromide paper. Each officer to submit for examination: Two landscapes; negatives, silver and blue prints, two photographic copies; negatives, silver and blue prints, negative of map, with three blue and three bromide prints. Text-books: Griffin's Notes on Photography; von Sothen's The Development of the Latent Image on Gelatino-Bromide of Silver.

20. The instruction of enlisted men will be restricted to a weekly detail of one noncommissioned officer. Each noncommissioned officer taking the course will submit six specimens of his own work for examination.

V.—Instruction of the Battalion.

21. Each company commander will devote one month to the instruction of his command in submarine mining. In this he will be assisted by the officers detailed as provided in paragraph 1.

22. One month to instruction in nomenclature, dimensions and construction of field and siege batteries, saps, and land mines.

23. Two months to pontoniering and spar bridges.

24. So much of two months as may be found necessary will be devoted to company and battalion instruction in close and extended order, marching, camping, advance guard and outpost duties, and target practice.

25. Company commanders will require lieutenants who have not already done so, and selected noncommissioned officers, to make satisfactory foot reconnaissances about 4 miles long, or reconnaissance of position of equivalent area, in the vicinity of the post. Maps will be submitted to post headquarters on or before November 30, 1896.

Lieutenants will be required also to make satisfactory mounted reconnaissances.

26. Instruction in signaling will be given until at least four enlisted men in each company attain the proficiency required by paragraph 1544 Army Regulations.

By order of Major Knight:

Wm. E. Craighill,
First Lieutenant, Corps of Engineers, Adjutant.

Programme of Study and Instruction for Winter Season.

[Printed Order, No. 48.]

United States Engineer School,
Willets Point, N. Y., November 30, 1896.

The following programme of study and instruction for the ensuing winter season, commencing December 1, 1896, and ending May 31, 1897, having been recommended by the academic staff and approved by the Chief of Engineers, is published for the information and guidance of all concerned:

I.—Detail of Officers.

Details of officers for academic duty will be made by the adjutant. Instructors will meet their classes at least weekly for assignment of lessons and examinations. As far as needful they will supplement the course with lectures. Examinations by the academic staff will be held about the end of February and May. Marks at all examinations will be on the West Point system, and the results will be reported weekly to the commandant of the school.

II.—First Winter's Course.

1. For engineer officers: Electricity and submarine mining, twenty-one weeks; civil engineering, three weeks. For officers detailed for special instruction in submarine mining: Electricity and submarine mining, twenty-four weeks.

ELECTRICITY.

2. Its application to torpedo warfare, arc and incandescent lighting, and transmission of power, supplemented by extensive laboratory practice in the solution of the special problems involved. Text-books and books of reference as follows: Abbot's

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Notes on Electricity; Ayrton's Practical Electricity; Thompson's Electricity and Magnetism; Maier's Arc and Glow Lamps; Swinburn's Practical Electrical Measurements; Kapp's Electrical Transmission of Energy; Part II of Professional Papers No. 23, Corps of Engineers, United States Army; Gray's Absolute Measurements, Volume II; Monroe and Jamieson's Pocket Book of Electrical Rules and Tables; Thompson's Dynamo Electric Machinery.

SUBMARINE MINING.

3. Text-books: The Manual of Submarine Mining. Practice will be had in making all the adjustments and tests required in planting and operating submarine mines, the operations on the water being simulated as far as practicable by special indoor appliances. Books of reference: Bucknill's Submarine Mines and Torpedoes, as applied to harbor defense; Scheidnagel's Treatise upon Defensive Submarine Mining.

4. Attendance at the electrical laboratory will be regulated by the instructor. All laboratory work will be done without the use of text-books or text-book diagrams. Officers may, however, use manuscript notes or diagrams previously prepared. Laboratory practice will be had from 9 a. m. to 12 m., and from 1 to 4 p. m.

CIVIL ENGINEERING.

5. Subjects: Adjustment and care of instruments and their use in (1) topographical surveying with transit and stadia; (2) hydrographic surveying and gauging of rivers; (3) geodetic and railway surveying. Text-books: Johnson's Theory and Practice of Surveying; Henck's Field Book for Engineers.

III.—SECOND WINTER'S COURSE.

No students present.

IV.—THIRD WINTER'S COURSE.

1. Military engineering, eight weeks; civil engineering, eleven weeks; submarine mining, five weeks.

MILITARY ENGINEERING.

2. Subjects: (1) Modern forts; (2) minor tactics and strategy; (3) logistics; (4) army organization; (5) war game; (6) problems; (7) laws affecting relations between civil and military authorities.

Text-books: Wagner's Organization and Tactics and Security and Information; Wisser's Minor Tactics; Army Regulations; Drill Regulations.

Reference books: Proceedings of the International Congress of Engineers, 1893; Mercur's Elements of the Art of War; Hamley's Operations of War; Bigelow's Principles of Strategy; Von Moltke's Tactical Problems; Derrécagaix's Modern War, etc.

CIVIL ENGINEERING.

3. Subjects: (1) Wave and current action and improvement of harbors; (2) estimates; (3) steam engines and pumps.

Text-books: (1) Annual Reports of Chief of Engineers; (2) Transactions American Society of Civil Engineers; (3) Catalogue of War Department Exhibit, World's Columbian Exposition, 1893, with models and photographs; (4) Selections from Harcourt's Harbors and Docks; Thurston's Manuals of Boilers and Steam Engines.

Books of reference: Trautwine's Engineers' Pocket Book; Stevenson's Canal and River Engineering; Wheeler's Tidal Rivers; Proceedings of the International Congress of Water Transportation, 1893.

SUBMARINE MINING.

4. Officers will instruct enlisted men of their companies in the duties of the loading room and boat service.

V.—ASSIGNMENT OF INSTRUCTORS.

The following assignment of instructors has been made:

Civil engineering: Capt. S. W. Roessler, Corps of Engineers.

Military engineering: Capt. Theo. A. Bingham, Corps of Engineers.

Submarine mining: Capt. Wm. C. Langfitt, Corps of Engineers.

Military photography: First Lieut. E. W. Van C. Lucas, Corps of Engineers, battalion quartermaster.

By order of Major Knight:

WM. E. CRAIGHILL,
First Lieutenant, Corps of Engineers, Adjutant.

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PROGRAMME OF STUDY AND INSTRUCTION FOR SUMMER SEASON.

[Printed Orders, No. 19.]

UNITED STATES ENGINEER SCHOOL,
Willets Point, N. Y., May 29, 1897.

The following programme of study and instruction for the ensuing summer season, commencing June 1 and ending October 31, 1897, having been approved by the Chief of Engineers, is published for the information and guidance of all concerned.

I.—SUBMARINE MINING.

1. After receiving such preliminary practice as may be necessary to acquaint them with the practical details, the officers of the class in submarine mining will be detailed for the purpose of taking charge of preparing and planting mines.
2. Officers so detailed will report to company commanders for the duty above stated. Daily journals of operations will be kept. Officers will frequently interchange duties so that each may have experience in each part of the drill.
3. When relieved each officer of the class in submarine mining will submit to the instructor, through the company commander, a report of the work done by him, mentioning difficulties encounted and any suggestions he may desire to make.
4. Hours of work will be those designated for fatigue duty.
5. Occasionally loaded mines will be planted and fired as in actual service, height of jet, effect on neighboring mines and other phenomena being carefully observed and recorded.
6. The electric light will be set up and operated.
7. When the mines are taken up the parts are to be dismantled, cleaned, and conveniently grouped, after which they will be inspected.
8. A detailed record will be kept of what each enlisted man does with the view of tracing out the author of defective work and determining the degree of proficiency developed. An account of the character of work done by each man will be submitted by the company commander at the close of the work of his company.
9. Officers of the class in submarine mining will make practical experiments in calibrating commercial ammeters and voltmeters, testing efficiency of dynamos and motors, and execute other work, under the supervision of the instructor.

II.—CIVIL ENGINEERING.

10. A topographical survey of about one-half square mile of ground will be made by each officer of the first year's class. Time allotted, five weeks.

III.—PRACTICAL ASTRONOMY.

11. Officers of the first year's class will constitute the observers.
12. The following will be the ordinary routine of observations with the several instruments, after reasonable proficiency has been attained by preliminary practice:

THEODOLITE.

Determination of azimuth.

SEXTANT.

After becoming skillful in the use of this instrument upon the sun, observers will deduce at least one satisfactory latitude by observing a north and a south star, using the time deduced from an east and a west star, each based on ten altitudes taken on the same night. These observations for latitude and time must be made at the observatory. The observer may get "time" from an assistant using a portable chronometer, and will determine by comparison the error of the standard chronometer at the observatory.

CHRONOGRAPH.

Daily determination by time signal from Washington, D. C., of error and rate of astronomical clock.

TRANSIT.

A satisfactory set of time observations will be taken by each officer on two nights, successive if possible, determining satisfactorily the error of the sidereal clock. The eye and ear method will be employed.
13. Problems will be submitted upon suitable blank forms, complete in every detail, before October 31, 1897.
14. Hours of attendance at the observatory will be regulated by the instructor.

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IV.—MILITARY PHOTOGRAPHY.

15. The laboratory, apparatus, etc., will be under the charge of the battalion quartermaster, who will submit to this office monthly reports showing the nature of the instruction given, the results attained, and the progress made.

16. The course will be for student officers reporting during the summer season. Time allotted, five weeks.

17. Other officers are invited to avail themselves of the advantages of the laboratory, making such arrangements with the officer in charge as shall insure no confusion in his official duties, or in those of the men under his instruction.

18. Practice will be had in the following methods: Negatives by dry process; developers and intensifiers; silver printing and finishing and mounting of prints; map printing by the blue process and on bromide paper. Each officer to submit for examination two landscapes, negatives, silver and blue prints; two photographic copies, negatives, silver and blue prints; negative of map, with three blue and three bromide prints. Text-books: Griffin's Notes on Photography, von Sothen's The Development of the Latent Image on Gelatino Bromide of Silver.

19. The instruction of enlisted men will be restricted to a weekly detail of one from those noncommissioned officers who have shown special aptitude during the last winter's course of instruction. Each noncommissioned officer taking the course will submit six specimens of his own work for examination.

V.—INSTRUCTION OF THE BATTALION.

20. Each company commander will devote one month to the instruction of his command in submarine mining. In this he will be assisted by the officers detailed as provided in paragraph 1.

21. One month to instruction in nomenclature, dimensions and construction of field and siege batteries, saps and land mines.

22. Two months to pontoniering and spar bridges.

23. One month will be devoted to company and battalion instruction in infantry drill regulations.

24. Company commanders will require lieutenants who have not already done so and selected noncommissioned officers to make satisfactory foot reconnaissances about 4 miles long, or reconnaissance of position of equivalent area, in the vicinity of the post. Maps will be submitted to post headquarters on or before October 31, 1897.

Lieutenants will be required also to make satisfactory mounted reconnaissances.

25. Instruction in signaling will be given until at least four enlisted men in each company attain the proficiency required by paragraph 1544, Army Regulations.

By order of Major Knight:

W. V. JUDSON,
First Lieutenant, Corps of Engineers, Adjutant.

The courses of study named below have been satisfactorily completed by the following officers:

The full course:

Second Lieut. W. B. Ladue, Corps of Engineers.
Second Lieut. W. J. Barden, Corps of Engineers.

The first winter's course:

Second Lieut. E. H. Schulz, Corps of Engineers.
Second Lieut. H. Burgess, Corps of Engineers.

The special course in submarine mining:

First Lieut. Wilson Chase, Twenty-second Infantry.
Second Lieut. M. A. Batson, Ninth Cavalry.
Second Lieut. W. D. Davis, Seventeenth Infantry.
Second Lieut. G. H. McMaster, Twenty-fourth Infantry
Second Lieut. C. G. Sawtelle, jr., Second Cavalry.
Second Lieut. W. H. Mullay, Twenty-first Infantry.

The winter's course in submarine mining:

Second Lieut. W. T. Johnston, Tenth Cavalry.
Second Lieut. F. A. Wilcox, First Infantry.
Second Lieut. W. C. Rogers, Seventh Infantry.
Second Lieut. F. B. McKenna, Fifteenth Infantry.
Second Lieut. W. A. Raibourn, Fourth Infantry.

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Besides the oral examinations conducted weekly in the different departments of theoretical instruction, written examinations were held in the months of March and May. Oral examinations in military engineering and submarine mining were held in March before the following officers of the Corps of Engineers, constituting the Board of Visitors:

Col. H. M. Robert.
Col. George L. Gillespie.
Lieut. Col. William Ludlow.
Maj. H. M. Adams.
Capt. H. F. Hodges.

This Board also examined the work of the officers instructed in photography.

May 25, 1897, the composition of the Board of Visitors was changed. Prior to this date it consisted of The Board of Engineers for Fortifications and such other officers of the Corps of Engineers above the rank of major as were stationed in New York City; and it was required to visit the school twice each year.

On the date stated the Secretary of War approved the recommendation of the Chief of Engineers that the Board of Visitors thereafter should consist of three officers of the Corps of Engineers, the president of The Board of Engineers for Fortifications to be ex officio a member, the other two members to be selected by the Chief of Engineers; the Board to visit the school but once annually, soon after the close of the winter course, and make a thorough and detailed inspection of everything connected with it, submitting a report thereof to the Secretary of War, through the Chief of Engineers, with such recommendations in reference to the school as may be deemed necessary. In consequence, the inspection of the school June 21, 1897, was made by a Board of Officers of the Corps of Engineers as follows:

Col. Henry M. Robert.
Col. George L. Gillespie.
Maj. Henry M. Adams.

III.—BATTALION OF ENGINEERS.

The maximum legal enlisted strength of the battalion is 752 men. The authorized strength is at present 500 men, distributed into four companies, one of the companies allowed by law existing on paper only.

Attention is invited to the need of an increase of the number of engineer troops.

For planting one grand group of mines, 2 officers, 3 noncommissioned officers, and 24 privates are needed, as well as sailors and laborers.

During the past twelve years the number of enlistments in the battalion has averaged 72; and this year the number was 160. Only the noncommissioned officers at West Point are instructed in submarine mining; in other words, 80 men of the company stationed there know nothing of that duty. It is safe to assume that at any time there are at least 120 men in the battalion not available for planting mines, though they might be utilized at the depot. Deducting these from the present authorized strength, 380 remain, or only enough to simultaneously plant 14 grand groups. At many of our harbors two or more grand groups should be planted simultaneously. It is evident that the battalion of engineers can not prepare the submarine mine defenses of our many harbors simultaneously.

Russia has eight companies for submarine mining service—two companies of 200 men each, and six companies of 100 men each.

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The necessity of an immediate increase in the number of engineer troops becomes thus apparent.

Instead of one battalion there should be two, each composed of four companies, having the maximum legal enlisted strength of 150 men. But the increase should be in officers as well as enlisted men. There are at present but four lieutenants on duty with the companies at this post and soon there will be but three. When the captains commanding companies are relieved, difficulty is experienced in finding available officers to replace them. Each company should be officered by a captain and three lieutenants. Each battalion should have its field officer, and the two battalions their regimental commander, a colonel.

Apart from any increase in the Corps demanded by the continued increase in the duties assigned to it, the submarine mine defense of our harbors demands the increase of its present authorized strength by 1 colonel, 1 major, 4 captains, 15 first lieutenants, 5 second lieutenants, and 700 enlisted men of various grades.

Part of this increased force should be stationed on the Pacific Coast, for when hostilities are imminent there may not be time to spare for the transfer of troops across the continent, especially when their services will be among those first required. Another part should be stationed at some point nearer the Gulf and South Atlantic coasts than this post is.

During the year the battalion, except Company E, has been regularly stationed at Willets Point, N. Y. Company E is at West Point, N. Y.

DRILL AND INSTRUCTION.

During the year all the companies have been drilled in pontoniering, laying out and constructing field works and intrenchments, and building spar bridges. All have drilled as infantry in the school of the company, and those at Willets Point in the school of the battalion.

The companies at Willets Point have received instruction, both in the winter and summer, in submarine mining, and one company has had instruction in land mining, while sinking shafts in two pits of the mortar battery and connecting the same by a tunnel, which work has a practical object and at the same time has afforded an opportunity for practice in mining.

Selected men of all the companies have been practiced in signaling and reconnaissance work.

The captain commanding Company E, at West Point, assisted by his officers and men, instructs the cadets in practical military engineering and in signaling.

August and September, 1896, were designated by the Chief of Engineers as the target-practice season for the companies stationed at Willets Point, and regular courses in practice were pursued by them at the range at West Point. The practice of Company E was held during September and October.

MARCHING, CAMPING, AND PARADES.

From August 4 to September 24, inclusive, the three companies, in turn, marched to camping ground at West Point, N. Y., from Fort Lee, on the right bank of the Hudson, and after a stay of two weeks, devoted to camping and target practice, returned on the left bank across to Fort Schuyler, whence they returned to the post, one company by steamer *Meigs* and two by pontons. The distance marched each way was about 54 miles. The march up began at Fort Lee in the middle of

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the afternoon and was completed early in the morning of the fourth day following. The return march was commenced in the morning and completed early on the third day following.

Acting Hospital Steward Vitou accompanied each command in both directions, and is commended for his intelligent care of the men needing his attention.

The men carried their campaign outfit, including shelter tents and rifles. As determined by the commanding officer of Company C, the weight carried was 42 pounds per man. Blanket rolls seemed to be preferred to knapsacks, especially as they could be shifted to either shoulder.

The transportation furnished was one wagon and four horses belonging to the post. The wagon weighed 2,250 pounds and its maximum load was 5,680 pounds. The load comprised rations and forage for five days.

The tentage for camp at West Point, mess equipage, and dress uniforms were taken to West Point by Government steamer.

The extra expense to the United States involved by these marches was that of two trips of the steamer from Willets Point to West Point and return, the cost of ferriage at West Point, about $14 for purchase of fuel for camps en route, and the cost of replacing one horse which fell dead on the way back to this post with no load and after a rest of some days at West Point.

The company funds received the benefit arising from savings of rations, but were reduced by about $475. Of this, about $265 was expended on the marches, about 50 per cent for meat and 20 per cent for bread.

* * * * * * *

While the time at West Point was devoted to target practice, the main object had in view during the absence of the companies from the post was experience in camping, messing, and marching. The fullest experience in messing was not obtained, as opportunities for purchasing supplies and available company funds rendered departures from the army ration possible, and the purchase of bread prevented the use of the flour ration.

The battalion participated in special parades during the year, as follows:

July 4, 1896, headquarters, band, and Companies A, B, and C left post at 7.10 a. m. en route for Brooklyn; participated in unveiling statue of Gen. G. K. Warren, and returned to post at 2 p. m.

March 3, 1897, the battalion (except Company E) left post at 6.15 a. m. and proceeded by boat and rail to Washington, D. C., arriving about 6 p. m.; March 4, 1897, it participated in the inaugural parade; it was quartered for two nights in corridors of War and Navy Department building, and left Washington, D. C., on the morning of March 5, 1897, arriving at post about 8.30 p. m. on same day. Company E joined the command at Jersey City en route for Washington, and was detached at the same point returning. Three days' travel rations were taken along for the subsistence of the troops, and were supplemented by liquid coffee purchased en route and in Washington.

April 27, 1897, the battalion participated in the parade in New York City, attending the transfer of the tomb of General Grant. The troops from Willets Point left the post at 6.20 a. m., returning at 4.15 p. m. Company E joined the command in New York City.

May 15, 1897, headquarters, band, and Companies A, B, and C left post at 4 a. m. en route for Philadelphia, Pa.; participated in ceremonies attending the unveiling of the Washington monument, and returning arrived at this post at midnight.

May 31, 1897, headquarters, band, and Companies A, B, and C left post at 6.30 a. m. en route for New York; participated in the Memorial Day parade, and returning arrived at this post at 1.10 p. m.

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RECRUITING, DISCIPLINE, ETC.

Recruits have been obtained by enlistment at Willets Point and West Point and from various general recruiting stations.

The following is a statement of the changes among the enlisted men:

Gain:	
Enlisted in battalion (Willets Point, 26; West Point, 11)	37
Recruits from other sources (Willets Point, 93; West Point, 21)	114
Reenlisted (Willets Point, 48; West Point, 3)	51
By transfer (Willets Point)	8
From desertion (Willets Point)	1
Total gain	211
Loss:	
Discharged by expiration of service (Willets Point, 47; West Point, 3)	50
For disability (Willets Point, 3; West Point, 3)	6
Sentence of general court-martial (Willets Point, 10; West Point, 2)	12
By order	31
Under General Orders 80, Adjutant-General's Office, 1890	58
Transferred	7
Retired (Willets Point, 2; West Point, 1)	3
Died	1
Deserted (Willets Point, 8; West Point, 5)	13
Total loss	181

The net gain is 30 enlisted men, which leaves the battalion with 5 recruits required.

The following table gives a comparative statement of recruiting, desertion, etc., during the past eleven years:

Fiscal year.	Recruiting.		Average daily number.		Deserted.	Trials.			Number of men on June 30.
	Enlisted.	Reenlisted.	Arrest or confinement.	Sick.		General court-martial.	Garrison court-martial.	Summary court-martial.	
June 30, 1886, to June 30, 1887	20	28	9	17	49	19	160	.....	388
June 30, 1887, to June 30, 1888	9	24	12	22	49	21	218	.....	387
June 30, 1888, to June 30, 1889	90	29	6	20	23	4	214	.....	402
June 30, 1889, to June 30, 1890	147	64	9	14	52	13	304	.....	468
June 30, 1890, to June 30, 1891	50	59	6	12	15	12	60	138	417
June 30, 1891, to June 30, 1892	83	42	5	10	24	19	4	208	427
June 30, 1892, to June 30, 1893	63	31	6	11	17	18	8	156	418
June 30, 1893, to June 30, 1894	111	39	6	13	25	27	4	125	466
June 30, 1894, to June 30, 1895	42	50	4	10	12	3	7	194	470
June 30, 1895, to June 30, 1896	30	40	7	11	20	28	1	202	465
June 30, 1896, to June 30, 1897	160	51	8	10	13	32	5	167	495

The following shows the number of different men tried and other facts relative to the trials:

	Number of men.	Number of trials.
Tried once	68	68
Tried twice	29	58
Tried three times	18	54
Tried four times	6	24
Total	121	204

Number of men who pleaded guilty	186
Number of men who pleaded not guilty	18
Total	204
Number of acquittals	6
Number of men found guilty	198
Total	204

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ROSTER OF COMMISSIONED OFFICERS.

Maj. John G. D. Knight, commanding.
First Lieut. W. V. Judson, adjutant, commanding Company D.
First Lieut. E. W. Van C. Lucas, quartermaster.
Capt. S. W. Roessler, commanding Company A.
Capt. James L. Lusk, commanding Company E.
Capt. G. D. Fitch, commanding Company C.
Capt. W. C. Langfitt, commanding Company B.
First Lieut. E. E. Winslow, Company E.
Second Lieut. W. B. Ladue, Company B.
Second Lieut. E. H. Schulz, Company C.
Second Lieut. H. Burgess, Company A.
Additional Second Lieut. G. M. Hoffman, Company B.

Statement of gains and losses.

GAIN.

Rank.	Name.	Joined.
Captain	Fitch, Graham D	May 21, 1897
First lieutenant	Judson, W. V	Mar. 2, 1897
Second lieutenant	Burgess, H	Sept. 30, 1896
Additional second lieutenant	Hoffman, G. M	June 30, 1897

LOSS.

Rank.	Name.	Relieved.
Captain	Bingham, Theo. A	Mar. 8, 1897
Do	Craighill, W. E	Mar. 6, 1897
First lieutenant	Sewell, J. S	Mar. 20, 1897
Do	Morrow, Jay J	Sept. 30, 1896
Second lieutenant	Walker, M. L	July 12, 1896
Do	Johnston, R. P	Sept. 14, 1896
Do	Raymond, R. R	July 17, 1896
Do	Barden, W. J	June 15, 1897

IV.—ENGINEER DEPOT.

I. Depot property and buildings have been cared for, the general work of keeping the same in a proper state of preservation having been performed entirely by enlisted men of the Engineer Battalion, detailed on extra duty.

II. The building containing the engineer models and the library of the United States Engineer School, the astronomical observatory, the officers' torpedo laboratory, the enlisted men's torpedo laboratory, the dynamo and boiler house, and the engineer stable were thoroughly painted, and minor needed repairs to all these buildings made. A new floor was placed in the instrument repair shop, and other minor repairs were made. The roundhouse (model room) was painted and necessary repairs to it were made, but the roof needs and will be given a second coat of paint.

III. The models in the museum were rearranged, labeled, repaired, and cleaned. Certain models designated for the War Department exhibit at the Tennessee Centennial were overhauled and packed, and shipped to the War Department representative at Nashville, Tenn., on April 17, 1897. These models, while on exhibition, are in the immediate charge of one sergeant and one private of the Engineer Battalion.

IV. Additions to the library of the United States Engineer School were made by the purchase of professional works of recent date, and

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twenty-five annual subscriptions to scientific periodicals and magazines, and by such other works as were received from time to time from the various Departments in Washington, also from colleges and schools; seventy-four volumes of Congressional documents were received from the Office of the Chief of Engineers, United States Army.

Unbound periodicals, magazines, etc., which had accumulated during the past five or six years were collected, assorted, and arranged, and missing numbers were, as far as possible, purchased. One hundred and seventy-seven complete volumes were thus secured, of which 160 were bound, funds available not sufficing for binding the remaining volumes.

The charge of the property of the library of the United States Engineer School was assumed by this office when the officer detailed as librarian was relieved from duty at this post, near the close of the fiscal year. The return of books, covering some 3,300 volumes, was then checked up, and but six found missing, one of which was of absolutely no value.

V. From the allotment made by the Chief of Engineers, U. S. A., July 18, 1896, apparatus necessary for conducting tests of cement was procured. It is now set up in the officers' torpedo laboratory.

An engine lathe, 17-inch swing and 8-foot bed, required for the depot repair shop, was procured at a cost of $335.

VI. Repairs were made to the bridge and ponton equipage by enlisted men of the Engineer Battalion detailed on extra duty. Twelve complete trestles were constructed.

Three hundred and fifty rack sticks, 30 pieces of timber for short balk, and 109 pieces of plank for chess were purchased.

VII. Two horses, authorized by the depot appropriation act, were procured during the year; also lumber, all for use in connection with the instruction of engineer troops.

VIII. Packing-boxes for shipping instruments and other materials were made. One desk was constructed for use of the department of military engineering; one letter-press stand for office; shelves for dynamo house for batteries; and one bookcase and shelves for library and museum.

DEPOT STEAMBOATS.

IX. *Steamer Bushnell.*—A new boiler and engine, at a cost of $9,050, were placed. While in dry dock, at the expense of the contractor for the engine, the hull was scraped and painted, and repairs as needed below her water line made. A new screw was also put in place.

Since the return to this place of the boat, extensive repairs to the hull, deck house, and parts of the machinery have been undertaken, and are still in progress, though they are not preventing the use of the boat.

Steamer Runaway.—Repairs to the machinery and hull were made from time to time; the hull and house on deck were scraped and painted; tubes in boiler were replaced, and all other repairs completed during the month of December.

Under authority of the Chief of Engineers, U. S. A., the *Runaway* was transferred to Colonel Hains, Corps of Engineers, U. S. A., on December 16, 1896.

Steam launch Raritan.—Submitted for the action of an inspector; condemned and broken up.

Torpedo planter Dyne.—Repairs were made to parts of the machinery, and the boat was painted.

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The pipe under the long wharf, by which the steamboats are supplied with water, was taken up, repaired, and relaid mostly above the dock to admit of drainage and thus avoid interruption by freezing.

INSTRUMENTS.

Various instruments in the depot have been cared for, additions have been made by purchase, and the work of issuing, receiving, repairing, and cleaning continued.

I. The following instruments were purchased:

Two engineer transits, 1 surveyor's level, 21 prismatic compasses, 49 pocket square compasses, 35 odometers, 117 Abbot's protractors, 2 brass pantographs, 11 clinometers, 19 aneroid barometers, 11 sets drawing instruments, 1 current meter, 6 pedometers, 2 level rods, 46 boxwood triangular scales, 6 boxwood flat scales, 1 triangular scale 18 inches, 2 100-foot steel tapes with spring handles, 7 dividers, 5 German silver protractors, 1 protractor T square, 60 rubber triangles, 1 4 by 7 foot drawing board, 2 steel rulers, 2 steel triangles, 1 50-foot steel tape, 1 beam compass with attachment, 2 ruling pens, 1 rolling parallel rule, 1 R. R. pen, and 125 cavalry sketching cases.

The cavalry sketching cases were of an improved pattern based upon suggestions received from officers who had used the pattern of the previous year.

Proposals for larger instruments, such as levels, transits, current meters, theodolites, etc., were invited from makers in Eastern, Central, and Western cities, with the condition that instruments must be supplied during the fiscal year at the prices bid. Several instruments were procured under these proposals when needed. Reference was made frequently during the year to them when officers of the Corps of Engineers needed instruments of various descriptions not available for issue from the depot. The object in view was to be able to secure at wholesale prices instruments suited to the work required of them without carrying in stock a lot of unsuitable instruments.

The total amount paid for all instruments purchased is $2,680.49.

II. Issues to officers of the Corps of Engineers and to officers detailed and on duty as acting engineer officers during the year were as follows:

Two engineer transits, 1 surveyor's level, 3 level rods, 86 cavalry sketching cases, 5 binocular field glasses, 16 aneroid barometers, 96 Abbot's protractors, 23 prismatic compasses, 53 pocket square compasses, 34 boxwood triangular scales, 6 boxwood flat scales, 1 triangular scale 18 inches, 8 steel triangles, 18 rubber triangles, 2 steel rulers, 6 rubber rulers, 33 odometers, 15 clinometers, 2 thermometers, 4 sextants, 4 sets of drawing instruments, 2 100-foot steel chains, 1 set of chain pins, 1 50-foot steel tape, 2 brass pantographs, 1 surveyor's compass, 6 pedometers, 5 german silver protractors, 2 100-foot steel tapes with spring handles, 1 4 by 7 foot drawing board and trestles for same, 1 rolling parallel rule, 1 trigonometer, 2 ruling pens, 7 dividers, 1 protractor T square, 1 beam compass with attachment, 1 R. R. pen, and various drawing materials.

A number of surveying instruments not included in the above were issued from time to time for temporary use to details from the engineer battalion engaged in making reconnaissances, instrumental and hydrographical surveys, in the vicinity of this post. These instruments, upon being returned, are overhauled and cleaned in the depot instrument shop.

A supply of 202,000 feet of paper suited for use with either tide gauges or cavalry sketching cases has been specially manufactured and delivered during the year. Of this there have been issued 7,500 feet to officers engaged on public works.

III. The following unserviceable instruments were received from offi-

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cers of the Corps of Engineers on public works and surveys, and from acting engineer officers, and now await the action of an inspector:

Five engineer transits, 4 engineer levels, 3 current meters, 1 theodolite, 2 surveyor's compasses, 1 prismatic compass, 5 odometers, and 2 aneroid barometers.

Two sectors and 2 telescopes belonging to the Repsold base apparatus were turned in during the year.

IV. The following instruments, received for repairs from various points, or on hand and needing repairs, were reissued after repairs were completed:

One transit, 1 aneroid barometer, 1 astronomical transit, 1 chronograph, 3 current meters, 1 current reverser, 6 odometers, 13 prismatic compasses, 1 engineer level, 1 surveyor's compass, and 1 camera for photographic use.

All of the repairing to depot instruments during the year has been done by enlisted men of the engineer battalion detailed on extra duty. In addition to the above instruments, a number of other smaller instruments, tools, electrical appliances, and musical instruments for the use of the band were kept in repair.

The cost of extra-duty pay for this work amounted during the fiscal year to $239.58.

Repairs were made to instruments elsewhere than at the post as follows:

At New York City, three sextants	$29.75
At San Francisco, Cal., three aneroid barometers	9.00
At St. Paul, Minn.:	
Two odometers	5.00
Five box compasses	7.85
One transit	9.25
Total	60.85

V. The following unserviceable instruments were inspected, condemned, and sold at public auction during the year:

Five artificial horizons, 1 aneriod barometer, 3 thermometers, 4 heliotropes, 4 surveyor's levels, 8 theodolites, 3 engineer transits, 1 spyglass, 2 binocular field glasses, 19 odometers, 10 compasses, 1 watch, 19 assorted protractors, 33 assorted scales, 1 stereoscope, and 1 pivot level.

TORPEDOES.

I. *Submarine mining materials and necessary appliances.*

Under allotments made from time to time from the appropriation for torpedoes for harbor defense submarine mining materials were procured, tested, and stored or shipped.

Materials were purchased during the year under proposals and contracts, and shipped as per accompanying list forwarded, not for publication, but for the files of the Office of the Chief of Engineers.

In addition all the necessary tools, such as pliers, pincers, vises, files, navy knives, etc., required for fitting out 304 tool boxes, in all 8,095 pieces, were procured.

Proposals were invited during the year for the following articles, and in each case the standard article is still to be determined upon:

Telephone outfits.—One set of three telephones has been delivered, but the makers being unwilling to make other sets of same pattern for fear of infringement on existing patents, a sample set of another pattern has been ordered.

Circuit detectors.—Specifications for 66 circuit detectors were pre-

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pared and several designs were submitted. A sample detector has been delivered, and it is now being tried.

Cable drum frames.—Specifications were prepared, but no suitable design was submitted by bidders. A sample frame is now being constructed, however.

Rubber jointing strips.—Considerable difficulty was encountered in procuring a satisfactory article. Persistent but unsuccessful attempts were made by one manufacturer to produce a suitable strip. More promising samples have recently been submitted by two parties.

II. *Torpedo experiments, etc.*

In addition to the usual laboratory work pertaining to torpedo instruction, such as testing cables, fuses, connecting wires, rewiring the building, setting up and operating electrical batteries, instruments, dynamos, etc., considerable improvements have been made in the system of submarine mining defense, for which Capt. William C. Langfitt, Corps of Engineers, is entitled to almost the entire credit.

The Board on Torpedo System was instructed July 11, 1896, to purchase and test a torpedo of the design of Lieutenant Halpine and submit report thereon. The testing of the torpedo was committed to me by the Board. The construction of the torpedo had not commenced at the close of the fiscal year.

NEW BUILDINGS.

At present repairs of instruments and other delicate machine work are carried on in an old frame building, more than 30 years old. A fireproof brick building is needed to replace this, and an estimate of $8,000 is submitted therefor.

STATEMENT OF FUNDS.

I. *Engineer Depot at Willets Point, N. Y.*—Congress appropriated for the fiscal year ending June 30, 1897:

1. For incidental expenses of depot (incidentals)	$5,000.00
2. For purchase of materials and one team of draft horses for instruction of battalion (materials)	1,000.00
3. For purchase and repair of instruments (instruments)	3,000.00
4. For library of the United States Engineer School: For purchase and binding of professional works of recent date treating of military and civil engineering (library)	500.00
Total	9,500.00

Of this, there has been expended and pledged:

1. For incidental expenses of depot (incidentals)	$4,994.09	
2. For purchase of materials and one team of draft horses for instruction of battalion (materials)	999.76	
3. For purchase and repair of instruments (instruments)	2,999.83	
4. For library of the United States Engineer School: For purchase and binding of professional works of recent date treating of military and civil engineering (library)	495.87	
		9,489.55
July 1, 1897, balance unexpended to be turned into the Treasury		10.45

II. *Apparatus for conducting tests of cement at Willets Point, N. Y.*—Under date of July 18, 1896, the Chief of Engineers, U. S. A., made the following allotment for the procurement of the apparatus necessary

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for conducting tests of cement at Willets Point, N. Y., from the following appropriations:

Preservation and repair of fortifications, act of June 6, 1896		$126.75
Examinations, surveys, and contingencies of rivers and harbors		250.00
Total		376.75
October 15, 1896, withdrawn	$37.30	
June 30, 1897, amount expended during fiscal year	339.45	
		376.75

III. *Torpedoes for harbor defense.*—The following allotments from the above appropriation were made from time to time and are available until expended:

1. Miscellaneous acts—For "purchase of submarine mining materials and necessary appliances:"		
July 1, 1896, balance unexpended		$3,804.72
June 30, 1897, amount expended during fiscal year		3,804.72
2. Act of August 18, 1890—For "torpedo experiments and instruction of engineer troops in submarine mining:"		
July 1, 1896, balance unexpended		18,492.60
June 30, 1897, amount expended during fiscal year		15,440.36
July 1, 1897, balance unexpended		3,052.24
July 1, 1897, outstanding liabilities		127.42
July 1, 1897, balance available		2,924.82
3. Act of June 6, 1896—For "purchase of submarine mining materials and necessary appliances:"		
July 17, 1896, amount allotted		32,000.00
June 30, 1897, amount expended during fiscal year		26,250.77
July 1, 1897, balance unexpended		5,749.23
July 1, 1897, outstanding liabilities		164.70
July 1, 1897, balance available		5,584.53
4. Act of March 3, 1897—For "purchase of submarine mining materials and necessary appliances," as recommended by the Board on Existing Torpedo System:		
April 8, 1897, amount allotted		75,000.00
July 1, 1897, balance unexpended		75,000.00
July 1, 1897, balance available		75,000.00

NEW APPROPRIATIONS.

The following items have been appropriated for the Engineer Depot at Willets Point, N. Y., for the fiscal year ending June 30, 1898, by the act approved March 2, 1897:

1. For incidental expenses of depot (incidentals)	$5,000.00
2. For purchase of materials for use of United States Engineer School and for instruction of engineer troops (materials)	1,500.00
3. For purchase and repair of instruments (instruments)	3,000.00
4. For library of the United States Engineer School; for purchase and binding of professional works of recent date treating of military and civil engineering (library)	500.00
Total	10,000.00

ESTIMATES.

There will be required for the fiscal year ending June 30, 1899, the following for the Engineer Depot at Willets Point, N. Y.:

1. For incidental expenses of the depot, including fuel, lights, chemicals, stationery, hardware; extra-duty pay to soldiers necessarily employed for periods not less than ten days as artificers on work in addition to and not strictly in the line of their military duties, such as carpenters, blacksmiths, draftsmen, printers, lithographers, photographers, engine drivers, teamsters, wheelwrights, masons, machinists, painters, overseers, laborers; repairs of and for materials to repair public buildings, machinery, and unforeseen expenses	$5,000.00

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2. For purchase of materials for use of United States Engineer School and for instruction of engineer troops at Willets Point in their special duties as sappers and miners, for land and submarine mines, pontoniers, torpedo drill, and signaling	$1,500.00
3. For purchase and repair of instruments, *and purchase of drawing materials*, to be issued to officers of the Corps of Engineers and to officers detailed and on duty as acting engineer officers, for use on public works, surveys, *and for the instruction of troops*	3,000.00
4. For library of the United States Engineer School: For purchase and binding of professional works of recent date treating of military and civil engineering and kindred scientific subjects	500.00
5. For a fireproof instrument-repair shop	8,000.00
Total	18,000.00

Remark 1, under item 3.—Changes in the wording of previous appropriation acts are indicated in italics. Requisitions are submitted from time to time by engineer officers of military departments for materials to be used in preparing military maps and for instruments and materials to be used in the instruction of troops in reconnaissance duty. To enable these requisitions to be filled by the Engineer Department the change in wording is recommended.

Remark 2, under item 5.—The fireproof instrument-repair shop is needed to replace a one-story, two-roomed frame building more than thirty years old, not worth repairing, and needing constant vigilance against danger of taking fire.

ABSTRACTS OF PROPOSALS.

1. *For furnishing 34,000 feet steel wire rope three-fourths inch diameter and 1,265 loose closed sockets, opened August 31, 1896, by Maj. John G. D. Knight, Corps of Engineers, U. S. A.*

No.	Name and address of bidder.	Price per foot for rope.	Price per piece for sockets.	Total of bid.
		Cents.		
1	John A. Roebling's Sons Co., New York	5	$0.96	$2,914.40
2	The Trenton Iron Co., New York	4 4/10	.96	2,710.40
3	John Claffy's Sons, New York	3 88/100	.64½	2,131.49
4	Hazard Manufacturing Co., New York	5 10/100	.96	3,118.40
5	Broderick & Bascom Rope Co., New York	4 10/100	.73	2,419.87
6	Harold C. Dayton & Co., New York	4 01/100	.92	2,524.27
7	Frank W. McNeal, New York	4 00/100	.74	2,486.50
8	S. P. Blackburn & Co., Boston, Mass	13 3/10	1.59	6,499.35
9	H. A. Rogers, New York	5 01/100	.75	2,823.00

The contract was awarded to John Claffy's Sons.

2. *For furnishing 126 torpedo cases, opened September 30, 1896, by Maj. John G. D. Knight, Corps of Engineers, U. S. A.*

Size and kind of torpedoes.		Continental Iron Works, Brooklyn, N. Y.	Morton Iron Works, Brooklyn, N. Y.
42 steel cases, 28 inches	each	$96.00	$77.50
2 steel cases, 34 inches	do	165.00	129.50
3 steel cases, 39 inches	do	187.00	144.00
6 steel cases, 43 inches	do	209.00	184.50
10 steel cases, 44 inches	do	220.00	207.75
21 steel cases, 48 inches	do	231.00	249.75
42 cast-iron cases	do	103.00	69.90
Total		17,554.00	15,311.05

The contract for 84 steel cases was awarded to the Continental Iron Works; for the 42 cast-iron cases to the Morton Iron Works.

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APPENDIX No. 3.

FORTIFICATIONS.

FISCAL YEAR 1896-97.

3 A.

COASTS OF MAINE AND NEW HAMPSHIRE.

Officers in charge, Lieut. Col. A. N. Damrell, Corps of Engineers, to April 27, 1897, and Maj. R. L. Hoxie, Corps of Engineers, since that date; assistant, Lieut. George P. Howell, Corps of Engineers, since July 13, 1896.

Portland Harbor, Maine; mortar battery for sixteen 12-inch mortars.—Work upon this battery was commenced November 30, 1896, and a double shift put on June 3, 1897, since which time 16 hours' work daily have been carried on, with as large a force as could be employed to advantage.

The following detailed tabular statement gives the estimated quantities of work, of work completed, and work remaining to be done.

Designation.	Estimated quantities.	Work done.	Remaining to be done June 30, 1897.
	Cubic yds.	*Cubic yds.*	*Cubic yds.*
Ledge excavation	36,143	16,143	20,000
Earth excavation	2,388	2,524	.....
Concrete	12,243	.....	12,243
Embankment	24,224	10,622	13,602

The work has been under the immediate charge of Lieut. George P. Howell, Corps of Engineers.

Money statement.

Allotments of July 3 and December 14, 1896		$125,000.00
June 30, 1897, amount expended during fiscal year		32,093.95
July 1, 1897, balance unexpended		92,906.05
July 1, 1897, outstanding liabilities	$15,431.00	
July 1, 1897, amount covered by uncompleted contracts	13,340.00	
		28,771.00
July 1, 1897, balance available		64,135.05

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EXTRACT FROM REPORT OF SECOND LIEUT. GEORGE P. HOWELL, CORPS OF ENGINEERS.

The work consists in the construction of a battery for sixteen 12-inch mortars. The battery is of the "rectilinear" type, but instead of all four pits being in line, it is divided into two parts, the parts being in echelon toward the sea. The magazine is in front of each part, the dimensions of its masonry being 206 feet by 34 feet; the distance between adjacent pits is 148 feet, and between the masonry of the two parts 105 feet. An open road, cut in the ledge and 20 feet wide at bottom, will lead to each pit.

The site is on the crest and rear slope of a hill 50 feet above the level of the sea; the embankment for the parapet will fall on the front slope. Thus there exist the most unfavorable conditions for a sunken battery, demanding a maximum of excavation and fill. The reason for this is that the reservation is small and mostly occupied for other purposes, leaving small choice in the matter of a site. A thin layer of earth overlies the ledge; hence most of the excavation was done in rock. This ledge for the first 10 or 15 feet is tough, black slate, irregularly stratified, abounding in seams and pockets of quartz, difficult to drill, and unfit for crushing for concrete purposes. A layer of serpentine overlay a portion of the battery. Below this hard bluestone is encountered, similar to the ledge at Portland Head. This will be crushed for the concrete.

The construction of a drain presented difficulties, as the lowest element to be drained was only 16 feet above the sea, and thus the drain had to pass 34 feet below the natural ground for 162 feet of its length after leaving the battery and be prolonged 72 feet under the parapet of the existing work before reaching the sea. A trench was excavated 20 feet wide at the top, 2 feet at the bottom, and in it the pipe laid. Tunneling was tried in the soft serpentine rock encountered, but without the vertical column, to which the steam drill could be fastened, it had to be given up. The roof and walls would also have to be shored up. At first the 18-inch vitrified pipe was laid in a 2-inch bed of sand upon the ledge and loam packed around and above it before the ordinary filling was placed thereon; later this was changed by substituting concrete for the sand and the loam and carrying it to a height of 2 feet above the pipe and arching the top.

Communication with Portland is by ordinary dirt road and a ferry. An electric car line passes by the site. A stone wharf already built enables cement to be landed and hauled by teams to the work. Portland has iron works, cement and lumber dealers, and in case of an emergency no delay is experienced in obtaining supplies. Supplies from Portland come by team via the ferry.

As work on the battery was begun November 30, 1896, it was in progress January 1, 1897. At that date stripping the earth from the ledge was the only work in progress, and the crew was composed of 1 overseer, 1 engineer, 1 drill runner, 1 blacksmith, and 72 men. On January 2, 1897, the first steam drill was set at work. Since then the greater part of the work has been in ledge excavation. On June 3 a second crew was set at work, the first crew working from 4 a. m. till 1 p. m. and the second from 1 p. m. till 8 p. m. On June 8 two 2,000-candlepower Wells lights were set up and the second crew's hours were prolonged till 10 p. m. On June 30 the employees were as follows: 1 overseer, 4 stokers, 10 drill runners, 4 master laborers, 16 teams and drivers, 1 timekeeper, 4 blacksmiths, 3 carpenters, 206 laborers.

The carpenters were at work preparing the false work for the concreting, which is expected to begin about October 1, 1897.

The plant in daily use consists of 2 upright tubular boilers, one 20 horsepower, the other 30 horsepower, which supply steam to 5 steam drills; 3 Ingersoll-Sergeant drills, 3¼-inch cylinder, and 2 Rand drills, 3¼-inch cylinder. Another Ingersoll-Sergeant drill has been purchased and will be put in operation upon the arrival of a third boiler, 30 horsepower.

A cement shed 80 by 28 feet, a sand bin 20 by 50 by 10 feet, and a stone bin 20 by 20 by 20 feet, have been erected. The cement will be delivered on the dock by the contractor and hauled to the shed at the Government's expense; the sand will be placed in the bin by the contractor, and the stone for crushing will be that excavated from the battery and crushed in a "Champion" rock crusher, capacity 35 tons per hour, for which a contract has been awarded.

A hoisting engine, wire cable, dump cars, two 4-foot cubical mixers, worm wheels, pulleys, etc., from the concreting plant at Buffalo, N. Y., under the charge of Maj. T. W. Symons, Corps of Engineers, have been forwarded and will be established for concreting purposes.

The 20-horsepower boiler was brought from Portland Head, where it was used last season; two of the three Ingersoll-Sergeant drills also came from there. The cost of the 30-horsepower boiler was $232; of the two Rand drills, $602.10, and of the third Ingersoll-Sergeant drill, $356.42.

The cement shed and bins were built by contract at a price of $822; the foundations of the bins and approach to the sand bin, the bottom of which is 6 feet from the ground, were constructed by the Government at a cost of $506.82.

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The two Wells lights cost $212.

The only cost in the plant from Buffalo was the freight and haulage, which amounted to $202.20.

Each steam drill is worked by a runner and a helper; holes were drilled about 5 feet apart to the full length of the longest drill, 16 feet. A blast was fired when from 20 to 30 holes were drilled. They were loaded with 60 per cent dynamite, at the rate of one-half of a pound to each foot of depth. The rock was then broken by hammers into pieces suitable for carting and removed in single dump carts, the pieces for crushing to be piled near the site of the crusher, and the loose and soft material to form the embankment. Wheelbarrows on wheeling plank were used in place of carts on short hauls and gentle grades, when the excavation was adjacent to the site for the embankment.

Ten thousand six hundred and twenty-two yards of excavated material have been deposited in the embankment. As this consists of fragments of rock unsuitable for crushing, mixed up with finer material from the excavation, it is not compact, and settling will take place; but the loam covering will not be placed for some time, and the mass is being consolidated by the pressing of the loaded carts.

Of the 24,000 cubic yards excavated (measured loose, assuming 1 yard in place=1.5 loose), 1,140 yards have been piled for the crusher, and 10,622 yards placed in the embankment; the remaining 12,300 yards, about, has been deposited in a spoil bank, filling up a swamp on the reservation. The construction of the trench for the drain prevented the bank from being made continuously; the area of the excavation was scattered, and the material had to be deposited in different positions. For these reasons carts were used to haul the material, and no trolley or cable line was set up. The only additional cost of the embankment was the price of two laborers to spread the material brought in the carts.

Two thousand five hundred and twenty-four yards of earth was removed at a cost of 90 cents per yard. This excavation was principally done in January, when the ground was frozen, and consisted in removing earth from the ledge in depths ranging from 6 inches to 3 feet. In one instance the holes were drilled by hand horizontally into the frozen face of the earth and the crust cracked with dynamite.

The total amount of rock excavation was 16,143 yards, divided as follows:

Drain.—Number of yards, 2,091; cost per yard for excavation and back fill, $2.39; average daily crew, one-half master laborer, 15 laborers; average daily amount excavated, 21.4 yards.

Two hundred and ninety-nine feet of 18-inch pipe were laid; cost per foot, including excavation, cost of pipe, laying pipe, and building manholes, $17.54.

Roadway.—Number of yards, 3,016; cost per yard, $1.39; average daily crew, one-half master laborer, 21 laborers, 6 carts; average amount excavated, 28 yards.

Battery.—Number of yards, 11,036; cost yer yard, $1.82; average daily crew, 1 master laborer, 45 laborers, 6 carts; average amount excavated, 83 yards.

This includes the cost of the labor and dynamite.

The expenditures were as follows:

Labor on earth excavation	$2,335.93
Labor on rock excavation	26,806.97
Dynamite	2,498.05
Supervision (overseer and timekeeper)	1,203.00
General workmen	529.24
Repairs to plant and buildings	236.93
General supplies, including cost of coal, lumber, picks, shovels, etc	872.71
Drain pipe	250.26
Holidays	364.22
Steam drills, boilers, and lights	699.26
Total	35,796.57

(One-half the original cost is included in this item in order to divide the expense proportionally.)

Cost per yard (including above):

Earth	$1.15
Rock	2.16

List of contracts, fiscal year 1897.

Name of contractor: W. G. Nash.
Date of contract: August 29, 1896.
Date of approval: September 16, 1896.
Time for commencement: On thirty days' notice.
Time for completion: As may be required.
Price for Portland cement: $2.05 per barrel.
Price for natural cement: 85 cents per barrel.

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Name of contractor: Frank W. Mason.
Date of contract: August 26, 1896.
Date of approval: September 1, 1896.
Time for commencement: On notice of ten days.
Time for completion: As required by the engineer.
Price for sand: 94 cents per cubic yard.

Emplacements for five 10-inch guns.—These emplacements are in two batteries, designated "B" and "C," for two and three guns respectively. On Battery B work was commenced in April, 1893, and is nearly completed. On Battery C work was commenced in October, 1894, and will be completed during the present season. Two of the gun carriages have been received at the site of the work, and four of the guns are now on the wharf at Fort Preble. The total expenditures on account of Batteries B and C are $163,382.32. The estimated cost is $208,786.10. The condition of the work is shown briefly in the following table:

Condition June 30, 1897.

Designation.	Emplacement.	Platform.	Carriage.	Gun.
Battery B:				
No. 1	Completed	Incomplete	Not received	On wharf, Fort Preble.
No. 2	do	Completed	On hand, not mounted.	do.
Battery C:				
No. 1	do	Incomplete	do	do.
No. 2	Incomplete	do	Not received	do.
No. 3	do	do	do	Not received.

This work has been under the immediate direction of Lieut. George P. Howell, Corps of Engineers, U. S. A., whose report gives in detail the work accomplished, and is herewith:

Money statement.

July 1, 1896, balance unexpended		$0.64
Allotments of July 3 and September 16, 1896		83,000.00
		83,000.64
June 30, 1897, amount expended during fiscal year		43,382.96
July 1, 1897, balance unexpended		39,617.68
July 1, 1897, outstanding liabilities	$8,563.36	
July 1, 1897, amount covered by uncompleted contracts	8,124.30	
		16,687.66
July 1, 1897, balance available		22,930.02

EXTRACT FROM REPORT OF SECOND LIEUT. GEORGE P. HOWELL, CORPS OF ENGINEERS.

The work has been the construction of emplacements for five 10-inch guns on disappearing carriages. On January 1, 1897, the condition of the work was as follows:

Battery B, Emplacement No. 1.—Emplacement completed, bolts for carriage set, and inner wall of shot chamber constructed; leaving to finish the outer wall and the loading platform.

Emplacement No. 2.—Emplacement and platform completed, with the exception of 2 yards of concrete in the floor of the shot chamber.

Battery C, Emplacement No. 1.—Emplacement and platform completed, with the exception of 14.5 yards in floor of shot chamber and in flight of steps.

Emplacements Nos. 2 and 3.—Excavation had been completed and the carriage bolts for No. 2 set.

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These batteries are located 4 miles from Portland, communication with which is over an ordinary country road. No wharf has ever been built, and all supplies are brought over this road. The cement is landed at a wharf 2¼ miles away, and delivered at the cement shed at the contractor's expense. The sand is delivered in the bin by the contractor. It is obtained from a pit, is coarse, and approximates to gravel, containing pebbles and fragments of stone, but it has been used for several years in the work and has given satisfaction. About eight-tenths of the sand passes through a mortar screen. The stone is obtained from the Government quarry on the reservation, worked by a contractor, and delivered by him to the crusher in pieces whose lateral dimensions are 5 inches by 10 inches. The rock is bluestone, and has been used during the entire construction of the batteries. The contractor did not commence to deliver his stone until the stone obtained last fall from the excavation for Battery C, and broken for crushing, had been exhausted.

The interior crest of Battery B is held at 65 feet above low water; of Emplacement No. 1, Battery C, at 75 feet, and of Emplacements Nos. 2 and 3, Battery C, 65 feet. This crest is on the summit of a rocky hill, and the greater part of the work is in excavation, and all concrete rests on solid ledge. The ledge is seamy, broken up by blasting, and water bearing. The batteries are well screened from observation seawards, as the parapet merges into the natural surface of the ground, which also adds to the earth protection. The base ring and traverse circle for Emplacement No. 1, Battery C, were in position January 1, 1897.

Work was in progress January 1, 1897, with a force of 1 overseer, 1 timekeeper, 1 watchman, and 56 laborers, setting the carriage bolts for Emplacement No. 2, Battery C; the work was completed January 9. As there was danger of freezing the concrete, the false work was carried up about 10 feet above the level of the traverse circle, a roof was put on and fire maintained day and night in a coal stove for ten days after the last concrete was put in. None of the concrete froze before setting. In December concrete was placed during the day when the thermometer was above 32° and protected at night with canvas, juniper bushes, and boards. The work was almost all satisfactory, one step requiring to be replaced. Two carpenters were set to work March 2, 1897, preparing the false work for the coming season, and during the period, March 2 to 13, the base ring and traverse circle for Emplacement No. 2, Battery B, were set. Both castings were set on steel wedges and leveled, then Portland cement mortar was placed under with trowels and thin steel bars till all the space between the castings and the concrete was filled. This method was considered better than floating with grout, as the shrinkage was less. The annular space between the concrete and bolts was filled with grout and the space between the bolt and casting with lead. The wedges were then cut off flush with the casting. From March 2 till March 13 manholes were cut to the bottom of the counterweight wells in Emplacement No. 2, Battery B, and Emplacement No. 1, Battery C. These manholes are 2 feet in diameter, start between the base ring and the circular recess in the parapet, go vertically down to the level of the bottom of the well, and then horizontally into the well between two of the base-ring bolts, which are 22 inches apart; the top of this portion is arched, but no attempt was made to strengthen it with iron. The manhole in Emplacement No. 1, Battery C, was being constructed July 1. It leads from the chamber in front of the platform and goes 11 feet horizontally through the concrete into the arched roof.

The season's work began April 19, and the force June 30 was as follows: One watchman, 1 timekeeper, 8 carpenters, 3 engineers, 2 master laborers, 1 stoker, 1 blacksmith, 103 laborers, 2 teams.

The first concrete was laid April 29, 1897. The plant in daily use is as follows: One Gates crusher No. 3, capacity 80 yards per day; 1 20-horsepower engine and boiler; 1 4-foot cubical box mixer with 15-horsepower engine and boiler; 1 hoisting engine and boiler, 15 horsepower, with double drum hoist 14 inches in diameter; 1 steam pump, Blake No. 1, that pumps water from an artesian well to a central tank; 4 side dump cars, capacity 1½ yards.

The concrete is mixed with the mixer and by hand. The mass is composed of Rosendale cement, in the following proportions: Cement 1, sand 3, and stone 4.

It is mixed by the mixer and taken care of by a crew of 44 men, viz: One engineer for the mixer; 1 engineer and stoker for the hoist; 1 master laborer; 2 laborers on cars going to the mixer; 4 on the sand barrows; 3 in the cement shed; 3 feeding and running the mixer; 2 on the concrete car; 4 shovelers; 8 wheelers; 2 spreaders; 8 rammers; 2 putting in bowlders; 2 sprinklers.

The stone is crushed by a crew of 1 engineer and 5 laborers feeding the crusher. The product, from one-half to 2½ inches, is dumped into a bin with bottom gates, while that under one-half inch passes through a chute, in which a screen with 100 meshes to the square inch separates the dust, and then falls into a bin, to be used in the face work of the concrete. This crusher has to be worked twelve hours per day in order to afford sufficient stone.

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A double track, 268 feet long, on trestles, leads from the stone bin to the mixer, passing by the sand bin and the cement shed. Two cars travel on this track; the car receives the amount of stone, is supplied with sand from a skip working on a horizontal axis and filled to the proper height with barrows, then with cement in a similar skip, and is emptied into a hopper over the mouth of the mixer; the mouth of this hopper enters into the door of the mixer to prevent loss of cement in dumping. The mixer is a 4-foot cubical box mixer, one-fourth inch steel plate, and driven by worm gearing. It is turned twelve times at a rate of eight turns per minute; the rotating shaft is bored axially with radial perforations by which the water admitted through a stuffing box at the extremity sprays the contents in the revolution. The amount of water per batch is about 10 gallons. The batch of concrete is received by a car which is drawn by the cable from the hoist up an inclined road, 534 feet long, where it is dumped onto a shoveling board and carried to its place in the parapet in barrows. Working at full capacity a batch is delivered every two minutes and forty seconds; but owing to delays, especially when beginning and leaving work, the greatest single day's run has been only 146 batches; the average number when the mixer runs at its utmost all day is 130, and the average daily number, counting every day of the forty it has run in this season, is 97¼.

One barrel of Rosendale cement goes into each batch; with proportions of 1, 3, 4, the number of cubic feet in each batch, measured loose, is 32; the mixer can not mix properly with a greater charge. This rams to 21 feet of concrete; hence the average number of yards put in daily was 76.

The floors, walls, and ceilings are made of Portland cement, with the composition of 1 cement, 2 sand, and 3 screenings from the crusher. The floors are 6 inches thick and have one-fourth inch of Portland cement mortar floated over the top. They are laid before the false work, before the walls are set up, affording better bearing for the saddles. The Portland cement finish of the walls and ceilings is 5 inches thick; a board is set up on edge that distance back from the face of the wall and the space filled with the fine concrete. The board is removed and this finish backed up by the coarse concrete. In making the face of the ceilings, the space between the roof beams is filled with Portland cement mortar and then the finish put on. The addition of the mortar makes the interior drier than in the older work, where none was used. The exposed surface of the parapet is finished to a depth of 6 inches with this Portland cement finish; it was divided into sections 2 feet deep and each section brought up continuously, affording no time for setting. In addition, to protect from blast of the gun in the area exposed, Portland cement was substituted for the Rosendale in the top 2 feet.

The crew on this work is composed of 2 carts and drivers and 32 men, viz: One master laborer, 3 laborers on sand barrows, 3 on stone barrows, 6 mixers on mixing board, 8 wheelers, 2 spreaders, 8 rammers, 1 sprinkler.

The carts haul the materials to the temporary bins near the board; the laborers on the barrows measure out the required proportions; the mortar is first mixed dry, then the stone and water added, and the mass turned over three times and shoveled into the barrows. Each barrel of cement makes 12 feet of finish. This method makes a very even, smooth finish, but there is a plane of weakness between it and the backing, as is shown by a continuous crack running all along, 5 inches back from the face of the wall. When the number of laborers on hand are sufficient, a third concreting crew of the same composition is employed, mixing the rough concrete by hand for the gun platforms.

The false work is prepared and set up in advance by a crew of 7 carpenters and 9 laborers. Dressed pine plank 1¼ inches thick is used on the exposed surfaces.

Bowlders as deflectors are incorporated into the mass of the concrete; they abound on the reservation, lying on the top of the ground, and are hauled to the parapet in a 2-horse drag. To enable them to be handled, the earth filling in front of the parapet has been carried up with the concrete, and the bowlders can be rolled from the drag into their position. They are as large as two men can handle with crowbars. The filling is obtained from a spoil bank where the excavated material last fall was deposited.

Considerable excavation was necessary over the site of Emplacements Nos. 2 and 3, Battery C, and in removing a retaining wall of concrete from the site of the platform in Emplacement No. 1, Battery B.

The cost of the materials delivered at the works is for—

Ironclad Portland cement	per barrel	$2.22
Beach Rosendale cement	do	.98
Sand	per yard	1.20
Stone, delivered at the crusher	do	1.23
Steel beams for the roof	per pound	.02

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The cost per yard for crushing the stone is 26 cents; the crusher has been in use for several years, and can not be worked to full capacity.

The expenditures were as follows:

General supervision	$575.00
General labor	575.09
Overhauling and rearranging plant	368.22
Excavation in earth and rock	854.98
Filling with earth and broken stone	815.09
Grading	108.25
Lumber and labor on false work	1,935.37
Labor on concreting	4,765.82
Cement (4,416 barrels Rosendale and 1,152 barrels Portland)	6,885.09
Sand (1,798.5 yards)	2,230.20
Stone (2,791 yards)	1,938.47
Bowlders and concrete	222.49
Cutting manholes	112.97
Setting traverse circle	78.97
Coal and engine supplies	321.73
Holidays	273.75
Total	22,091.49

Three thousand eight hundred and twenty-nine yards of concrete was laid as follows:

Battery B, Emplacement No. 1: 22 yards in floor and wall of shot chamber; 245 yards are required to complete this emplacement. Emplacement No. 2: 5.5 yards in floor of shot chamber. This emplacement is completed.

Battery C, Emplacement No. 1: 9.5 yards in floor of shot chamber; 5 yards are required to finish this emplacement. Emplacements Nos. 2 and 3: The concrete has been laid around the bolts in No. 2 162 yards, and 3 630 yards laid in the parapets and magazine; 5,545 yards are required to finish.

Cost of concrete per yard.

Cement	$1.798
Sand	.582
Stone	.506
Bowlders	.06
Concreting	1.244
False work	.505
Excavation and fill	.464
Supervision and general work	.60
Total	5.759

List of contracts, fiscal year 1897.

Name of contractor: Coolidge & Wait.
Date of contract: August 26, 1896.
Date of approval: September 17, 1896.
Time for commencement: On award of contract.
Time for completion: As may be required.
Price per barrel for Portland cement: $2.22.

Name of contractor: W. G. Nash.
Date of contract: August 29, 1896.
Date of approval: September 16, 1896.
Time for commencement: On 30 days.
Time for completion: As may be required.
Price per barrel for natural cement: 98 cents.

Name of contractor: George C. Place.
Date of contract: August 26, 1896.
Date of approval: September 16, 1896.
Time for commencement: On award of contract.
Time for completion: As required by engineer.
Price per cubic yard for sand: $1.20.

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Emplacements for two 12-inch guns.—This work was advertised and contract awarded February 27, 1897, to William Morgan. Under this contract work was commenced early in April and should be completed December 1, 1897.

The following tabular statement shows the condition of the work on June 30, 1897:

Designation.	Estimated quantities.	Work done.	Remaining to be done June 30, 1897.
	Cubic yds.	*Cubic yds.*	*Cubic yds.*
Earth excavation	2,800	2,517	283
Rock excavation	7,250	1,400	5,850

The artesian well has been carried to a depth of about 186 feet, and though good water has been obtained it is not in sufficient quantity. It has been tested by pumping out, and will probably be sunk deeper. The contractor has built a temporary wharf and has established his working plant, which includes a stone crusher with engine and boiler. Temporary buildings are under construction.

The walls of the permanent wharf have been carried up to the level of mean high tide, and the interior fill to an average height of about 3 feet less than the walls. Nothing has yet been done on the roadway leading to the wharf.

No unusual difficulties have been encountered excepting the prevalence of unfavorable weather in the early part of the season.

Money statement.

FOR CONTINGENCIES AND ENGINEERING.

Allotments of March 16 and 27, 1897	$3,200.00
June 30, 1897, amount expended during fiscal year	687.62
July 1, 1897, balance unexpended	2,512.38
July 1, 1897, outstanding liabilities	125.00
July 1, 1897, balance available	2,387.38

FOR CONTRACT WORK.

Allotment of March 27, 1897	70,000.00
July 1, 1897, amount covered by uncompleted contracts	70,000.00

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Abstracts of proposals for construction of gun emplacements, Portland Harbor, Maine, opened at Portland, Me., December 12, 1896, by Lieut. Col. A. N. Damrell, Corps of Engineers.

Items.	Approximate quantities.	1. William Morgan, Trenton, N. J.		2. Molloy & Sheehan, New Rochelle, N. Y.		3. Edward W. Everson, Providence, R. I.	
		Price.	Amount.	Price.	Amount.	Price.	Amount.
Excavation:							
Earth, measured in piles (including removal of woods), cubic yards	2,800	$1.50	$4,200.00	$0.35	$980.00	$0.30	$840.00
Rock, in place, cubic yards	7,250	3.00	21,750.00	1.25	9,062.50	2.00	14,500.00
Earth fill (additional), do	1,000	1.00	1,000.00	.35	350.00	.25	250.00
Bricks, in place, number	10,000	30.00	300.00	18.00	180.00	25.00	250.00
Concrete (aggregate obtained from excavation of site):							
No. 1 (body of work), in place, cubic yards	8,500	4.50	38,250.00	4.30	36,550.00	4.30	36,550.00
No. 2 (walls, etc.), in place, cubic yards	1,650	7.50	12,375.00	6.00	9,900.00	6.20	10,230.00
No. 3 (facings, etc.), in place, cubic yards	650	10.00	6,500.00	6.00	3,900.00	8.00	5,200.00
Broken stone (not in concrete), in place, cubic yards	370	.50	185.00	1.10	407.00	1.50	555.00
Concrete (aggregate obtained elsewhere):							
No. 1 (body of work), in place, cubic yards	8,500	6.00	51,000.00	4.85	41,225.00	5.30	45,050.00
No. 2 (walls, etc.), in place, cubic yards	1,650	9.00	14,850.00	7.00	11,550.00	7.20	11,880.00
No. 3 (facings, etc.), in place, cubic yards	650	15.00	9,750.00	7.00	4,550.00	8.50	5,525.00
Broken stone (not in concrete), in place, cubic yards	370	2.00	740.00	1.10	407.00	2.50	925.00
Steel I-beams and L's, in place, pounds	50,000	.03½	1,750.00	.03	1,500.00	.03	1,500.00
Trolley rails and trolleys, in place, pounds	10,000	.10	1,000.00	.10	1,000.00	.14	1,400.00
Galvanized wrought-iron tube, in place, linear feet	175	.25	43.75	.25	43.75	.20	35.00
White-pine lumber, in place, per foot B. M., feet B. M.	500	.04	20.00	.04	20.00	.10	50.00
Vitrified sewer pipe, in place (including traps, elbows, etc.):							
12-inch, linear feet	190	1.00	190.00	.80	152.00	.40	76.00
8-inch, do	200	.75	150.00	.60	120.00	.20	40.00
4-inch, do	250	.50	125.00	.30	75.00	.20	50.00
Cement pipe, in place, 4-inch, do	36	2.00	72.00	.30	10.80	.20	7.20
Steel bolts, with plates, nuts, etc., in place, pounds	9,840	.10	984.00	.05	492.00	.05	492.00
Iron ladders, in place, do	300	.10	30.00	.10	30.00	.08	24.00
Hand rails, in place, do	600	.10	60.00	.10	60.00	.08	48.00
Ammunition cranes, complete, in place, sets	2	500.00	1,000.00	200.00	400.00	350.00	700.00
Double ammunition lifts, complete, in place, pairs	2	1,800.00	3,600.00	70.00	140.00	1,000.00	2,000.00
Steel doors, in place, pounds	10,000	.08	800.00	.10	1,000.00	.08	800.00
Bronze gudgeons, hinges, and fittings, in place, pounds	500	.50	250.00	.30	150.00	.35	175.00
Artesian well, with lining, pump, complete, feet depth	100	25.00	2,500.00	6.50	650.00	10.00	1,000.00
Wharf and roadway:							
Split granite, for dry rubble wall, in place, tons	1,400	3.50	4,900.00	2.75	3,850.00	2.50	3,500.00
Rubble masonry, in Portland cement mortar, in place, cubic yards	90	7.50	675.00	6.00	540.00	7.00	630.00
Granite coping stone, in place, tons	84	4.00	336.00	3.00	252.00	4.50	378.00
Quarry grout, for roadway and pier, tons	5,700	1.50	8,550.00	1.50	8,550.00	1.25	7,125.00
Excavation of road (battery to shore), cubic yards	1,500	1.25	1,875.00	.75	1,125.00	.25	375.00
Oak fender piles, in place, number	11	20.00	220.00	8.00	88.00	10.00	110.00
Oak belaying posts, in place, number	4	40.00	160.00	4.00	16.06	10.00	40.00
Aggregate obtained from excavation of site	.....	.....	113,850.75	.....	81,594.05	.....	88,930.20
Aggregate obtained elsewhere	.....	.....	132,880.75	.....	88,569.05	.....	99,775.20
Commence work	.....	Apr. 1, 1897.		Apr. 1, 1897.		20 days after notice.	
Complete work	.....	Dec. 1, 1897.		Dec. 1, 1897.		6 months after Apr. 1, 1897.	

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Abstracts of proposals for construction of gun emplacements, Portland Harbor, Maine, opened at Portland, Me., December 12, 1896, etc.—Continued.

Items.	Approximate quantities.	4. The Hartford Paving and Construction Co., Hartford, Conn.		5. Mairs & Lewis, New York City.		6. Gardner C. Luther, Providence, R. I.	
		Price.	Amount.	Price.	Amount.	Price.	Amount.
Excavation:							
Earth, measured in piles (including removal of woods), cubic yards	2,800	$0.30	$840.00	$0.30	$840.00	$0.50	$1,400.00
Rock, in place.....cubic yards..	7,250	.74	5,365.00	1.50	10,875.00	1.25	9,062.50
Earth fill (additional).....do....	1,000	.40	400.00	.30	300.00	.35	350.00
Bricks, in place.....number..	10,000	12.00	120.00	15.00	150.00	18.00	180.00
Concrete (aggregate obtained from excavation of site):							
No. 1 (body of work), in place, cubic yards	8,500	3.48	29,580.00	3.00	25,500.00	3.42	29,070.00
No. 2 (walls, etc.), in place, cubic yards	1,650	5.74	9,471.00	6.00	9,900.00	5.00	8,250.00
No. 3 (facings, etc.), in place, cubic yards	650	9.50	6,175.00	10.00	6,500.00	8.00	5,200.00
Broken stone (not in concrete), in place.....cubic yards..	370	.97	358.90	1.50	555.00	1.50	555.00
Concrete (aggregate obtained elsewhere):							
No. 1 (body of work), in place, cubic yards	8,500	5.64	47,940.00	4.75	40,375.00	4.25	36,125.00
No. 2 (walls, etc.), in place, cubic yards	1,650	7.90	13,035.00	8.00	13,200.00	5.75	9,487.50
No. 3 (facings, etc.), in place, cubic yards	650	11.66	7,579.00	12.00	7,800.00	8.75	5,687.50
Broken stone (not in concrete), in place.....cubic yards..	370	3.13	1,158.10	3.00	1,110.00	2.50	925.00
Steel I-beams and L's in place, pounds	50,000	.03½	1,750.00	.03	1,500.00	.02½	1,375.00
Trolley rails and trolleys, in place, pounds	10,000	.11	1,100.00	.05	500.00	.20	2,000.00
Galvanized wrought-iron tube, in place.....linear feet..	175	.10	17.50	.20	35.00	.10	17.50
White-pine lumber, in place, per foot B. M..... feet B. M..	500	.06	30.00	40.00	20,000.00	.10	50.00
Vitrified sewer pipe, in place (including traps, elbows, etc.):							
12-inch.....linear feet..	190	.40	76.00	1.00	190.00	.50	95.00
8-inch.....do....	200	.27	54.00	.75	150.00	.35	70.00
4-inch.....do....	250	.18	45.00	.50	125.00	.20	50.00
Cement pipe, in place, 4-inch....do....	36	.15	5.40	.40	14.40	.20	7.20
Steel bolts, with plates, nuts, etc., in place.....pounds..	9,840	.05	492.00	.05	492.00	.02½	270.60
Iron ladders, in place.....do....	300	.05	15.00	.05	15.00	.12	36.00
Hand rails, in place.....do....	600	.06	36.00	.05	30.00	.30	180.00
Ammunition cranes, complete, in place.....sets..	2	270.00	540.00	300.00	600.00	335.00	670.00
Double ammunition lifts, complete, in place.....pairs..	2	740.00	1,480.00	1,200.00	2,400.00	1,400.00	2,800.00
Steel doors, in place.....pounds..	10,000	.06	600.00	.10	1,000.00	.14	1,400.00
Bronze gudgeons, hinges, and fittings, in place.....pounds..	500	.95	475.00	.25	125.00	.50	250.00
Artesian well, with lining, pump, complete.....feet depth..	100	12.25	1,225.00	10.00	1,000.00	6.50	650.00
Wharf and roadway:							
Split granite, for dry rubble wall, in place.....tons..	1,400	2.75	3,850.00	2.50	3,500.00	3.00	4,200.00
Rubble masonry, in Portland cement mortar, in place, cubic yards	90	6.05	544.50	5.50	495.00	6.00	540.00
Granite coping stone, in place, tons	84	3.05	256.20	3.00	252.00	3.00	252.00
Quarry grout, for roadway and pier.....tons..	5,700	1.75	9,975.00	1.00	5,700.00	1.38	7,866.00
Excavation of road (battery to shore).....cubic yards..	1,500	.80	1,200.00	1.50	2,250.00	.90	1,350.00
Oak fender piles, in place, number	11	9.00	99.00	5.00	55.00	10.00	110.00
Oak belaying posts, in place, number		7.25	29.00	10.00	40.00	8.00	32.00
Aggregate obtained from excavation of site	.....	.....	76,204.50	.....	95,088.40	.....	78,338.80
Aggregate obtained elsewhere	.....	.....	100,331.70	.....	115,118.40	.....	87,488.80
Commence work	.....	Apr. 15, 1897.		Feb. 1, 1897.		Jan. 1, 1897.	
Complete work	.....	Nov. 15, 1897.		Oct. 1, 1897.		Jan. 1, 1898.	

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Abstracts of proposals for construction of gun emplacements, Portland Harbor, Maine, opened at Portland, Me., December 12, 1896, etc.—Continued.

Items.	Approximate quantities.	7. Manhattan Concrete Co., New York City.		8. Clark & Co., New York City.		9. Isaac T. Brown, New York City.	
		Price.	Amount.	Price.	Amount.	Price.	Amount.
Excavation:							
Earth, measured in piles (including removal of woods), cubic yards	2,800	$0.70	$1,960.00	$0.60	$1,680.00	$0.50	$1,400.00
Rock, in place, cubic yards	7,250	.93	6,742.50	1.50	10,875.00	1.05	7,612.50
Earth fill (additional), do	1,000	.51	510.00	.25	250.00	.35	350.00
Bricks, in place, number	10,000	20.00	200.00	26.00	260.00	16.00	160.00
Concrete (aggregate obtained from excavation of site):							
No. 1 (body of work), in place, cubic yards	8,500	3.90	33,150.00	3.90	33,150.00	3.30	28,050.00
No. 2 (walls, etc.), in place, cubic yards	1,650	6.90	11,385.00	7.00	11,550.00	3.80	6,270.00
No. 3 (facings, etc.), in place, cubic yards	650	12.00	7,800.00	9.00	5,850.00	5.00	3,250.00
Broken stone (not in concrete), in place, cubic yards	370	.83	307.10	1.25	462.50	.70	259.00
Concrete (aggregate obtained elsewhere):							
No. 1 (body of work), in place, cubic yards	8,500	4.68	39,780.00	6.40	54,400.00	3.90	33,150.00
No. 2, (walls, etc.), in place, cubic yards	1,650	7.90	13,035.00	10.00	16,500.00	4.45	7,342.50
No. 3 (facings, etc.), in place, cubic yards	650	12.50	8,125.00	10.20	6,630.00	6.60	4,290.00
Broken stone (not in concrete), in place, cubic yards	370	1.50	555.00	2.80	1,036.00	1.20	444.00
Steel I-beams and L's, in place, pounds	50,000	.03¾	1,875.00	.04	2,000.00	.03	1,500.00
Trolley rails and trolleys, in place, pounds	10,000	.04	400.00	.12	1,200.00	.09	900.00
Galvanized wrought-iron tube, in place, linear feet	175	.25	43.75	.18	31.50	.50	87.50
White-pine lumber, in place, per foot B. M, feet B. M	500	.05	25.00	.08	40.00	.05	25.00
Vitrified sewer pipe, in place, including traps, elbows, etc.:							
12-inch, linear feet	190	.50	95.00	.90	171.00	.35	66.50
8-inch, do	200	.50	100.00	.70	140.00	.25	50.00
4-inch, do	250	.50	125.00	.30	75.00	.15	37.50
Cement pipe, in place, 4-inch, do	36	.50	18.00	.20	7.20	.30	10.80
Steel bolts, with plates, nuts, etc., in place, pounds	9,840	.04	393.60	.04½	442.80	.05	492.00
Iron ladders, in place, do	300	.10	30.00	.15	45.00	.05	15.00
Hand rails, in place, do	600	.10	60.00	.30	180.00	.05	30.00
Ammunition cranes, complete, in place, sets	2	500.00	1,000.00	200.00	400.00	220.00	440.00
Double ammunition lifts, complete, in place, pairs	2	600.00	1,200.00	800.00	1,600.00	750.00	1,500.00
Steel doors, in place, pounds	10,000	.05	500.00	.15	1,500.00	.04	400.00
Bronze gudgeons, hinges, and fittings, in place, pounds	500	.60	300.00	.50	250.00	.25	125.00
Artesian well with lining, pump, complete, feet depth	100	11.00	1,100.00	18.00	1,800.00	6.00	600.00
Wharf and roadway:							
Split granite, for dry rubble wall, in place, tons	1,400	3.00	4,200.00	3.00	4,200.00	2.90	4,060.00
Rubble masonry, in Portland cement mortar, in place, cubic yards	90	4.50	405.00	7.00	630.00	6.00	540.00
Granite coping stone, in place, tons	84	6.50	546.00	4.50	378.00	8.00	672.00
Quarry grout, for roadway and pier, tons	5,700	1.15	6,555.00	.30	1,710.00	1.40	7,980.00
Excavation of road (battery to shore), cubic yards	1,500	.80	1,200.00	.80	1,200.00	1.10	1,650.00
Oak fender piles, in place, number	11	15.00	165.00	15.00	165.00	10.00	110.00
Oak belaying posts, in place, number	4	15.00	60.00	7.00	28.00	10.00	40.00
Aggregate obtained from excavation of site			82,450.95		82,271.00		68,682.80
Aggregate obtained elsewhere			91,303.85		109,824.50		76,080.30
Commence work		Feb. 1, 1897, or before.		Feb. 1, 1897.		Feb. 1, 1897.	
Complete work		Dec. 1, 1897.		Nov. 1, 1897.		Oct. 30, 1897.	

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Abstracts of proposals for construction of gun emplacements, Portland Harbor, Maine, opened at Portland, Me., December 12, 1896, etc.—Continued.

Items.	Approximate quantities.	10. H. C. Moore, New York City.		11. Pennell & O'Hern, Yonkers, N. Y.		12. T. W. Kinser & Sons, Terre Haute, Ind., or Waltham, Mass.	
		Price.	Amount.	Price.	Amount.	Price.	Amount.
Excavation:							
Earth, measured in piles (including removal of woods), cubic yards	2,800	$0.30	$840.00	$0.40	$1,120.00	$0.30	$840.00
Rock, in place, cubic yards	7,250	1.10	7,975.00	2.00	14,500.00	2.20	15,950.00
Earth fill (additional), do	1,000	.25	250.00	.50	500.00	.30	300.00
Bricks, in place, number	10,000	20.00	200.00	25.00	250.00	20.00	200.00
Concrete (aggregate obtained from excavation of site):							
No. 1 (body of work), in place, cubic yards	8,500	4.00	34,000.00	3.60	30,600.00	3.70	31,450.00
No. 2 (walls, etc.), in place, cubic yards	1,650	6.75	11,137.50	7.00	11,550.00	7.00	11,550.00
No. 3 (facings, etc.), in place, cubic yards	650	11.00	7,150.00	10.00	6,500.00	13.00	8,450.00
Broken stone (not in concrete), in place, cubic yards	370	2.00	740.00	1.50	555.00	.75	277.50
Concrete (aggregate obtained elsewhere):							
No. 1 (body of work), in place, cubic yards	8,500	4.50	38,250.00	4.00	34,000.00	6.20	52,700.00
No. 2 (walls, etc.), in place, cubic yards	1,650	7.25	11,962.50	7.25	11,962.50	9.50	15,675.00
No. 3 (facings, etc.), in place, cubic yards	650	12.00	7,800.00	10.50	6,825.00	15.50	10,075.00
Broken stone (not in concrete), in place, cubic yards	370	2.50	925.00	1.75	647.50	3.00	1,110.00
Steel I-beams and L's in place, pounds	50,000	.02½	1,375.00	.04	2,000.00	.03	1,500.00
Trolley rails and trolleys, in place, pounds	10,000	.07	700.00	.05	500.00	.18	1,800.00
Galvanized wrought-iron tube, in place, linear feet	175	.50	87.50	.10	17.50	.10	17.50
White-pine lumber, in place, per foot B. M., feet B. M.	500	.20	100.00	.06	30.00	.05	25.00
Vitrified sewer pipe, in place, including traps, elbows, etc.:							
12-inch, linear feet	190	.60	114.00	1.00	190.00	.50	95.00
8-inch, do	200	.50	100.00	1.00	200.00	.40	80.00
4-inch, do	250	.30	75.00	.70	175.00	.30	75.00
Cement pipe, in place, 4-inch, do	36	.30	10.80	.70	25.20	.30	10.80
Steel bolts, with plates, nuts, etc., in place, pounds	9,840	.05	492.00	.08	787.20	.03	295.20
Iron ladders, in place, do	300	.04	12.00	.10	30.00	.08	24.00
Hand rails, in place, do	600	.04	24.00	.10	60.00	.18	108.00
Ammunition cranes, complete, in place, sets	2	200.00	400.00	50.00	100.00	250.00	500.00
Double ammunition lifts, complete, in place, pairs	2	1,000.00	2,000.00	1,000.00	2,000.00	1,200.00	2,400.00
Steel doors, in place, pounds	10,000	.04	400.00	.12	1,200.00	.10	1,000.00
Bronze gudgeons, hinges, and fittings, in place, pounds	500	.30	150.00	.25	125.00	.20	100.00
Artesian well with lining, pump, complete, feet depth	100	12.00	1,200.00	12.00	1,200.00	12.00	1,200.00
Wharf and roadway:							
Split granite, for dry rubble wall, in place, tons	1,400	4.00	5,600.00	2.75	3,850.00	2.75	3,850.00
Rubble masonry, in Portland cement mortar, in place, cubic yards	90	5.00	450.00	6.00	540.00	5.75	517.50
Granite coping stone, in place, tons	84	6.00	504.00	2.75	231.00	3.00	252.00
Quarry grout, for roadway and pier, tons	5,700	.25	1,425.00	1.50	8,550.00	1.75	9,975.00
Excavation of road (battery to shore), cubic yards	1,500	.50	750.00	.50	750.00	.75	1,125.00
Oak fender piles, in place, number	11	10.00	110.00	8.00	88.00	15.00	165.00
Oak belaying posts, in place, number	4	25.00	100.00	10.00	40.00	10.00	40.00
Aggregate obtained from excavation of site			78,471.80		88,263.90		94,172.50
Aggregate obtained elsewhere			84,381.80		92,493.90		122,005.00
Commence work		Mar. 20, 1897.		When directed to do so.		Feb. 1, 1897.	
Complete work		Nov. 1, 1897.		Dec. 1, 1897.		Nov. 1, 1897.	

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Abstracts of proposals for construction of gun emplacements, Portland Harbor, Maine, opened at Portland, Me., February 18, 1897, by Lieut. Col. A. N. Damrell, Corps of Engineers.

Items.	Approximate quantities.	1. I. L. Grim, Philadelphia, Pa.		2. William Morgan, Trenton, N. J.		3. Isaac T. Brown, New York, N. Y.	
		Price.	Amount.	Price.	Amount.	Price.	Amount.
Earth excavation (including the removal of woods), per cubic yard, cubic yards	2,800	$0.50	$1,400.00	$0.34	$952.00	$0.30	$840.00
Rock excavation, in place, per cubic yard.....cubic yards	7,250	1.00	7,250.00	1.50	10,875.00	1.25	9,062.50
Earth fill, per cubic yard.....do	1,000	.40	400.00	.29	290.00	.30	300.00
Bricks, in place, per thousand	10,000	20.00	200.00	18.00	180.00	12.00	120.00
Concrete No. 1, in place, per cubic yard.....cubic yards	5,700	4.75	27,075.00	3.18	18,126.00	3.95	22,515.00
Concrete No. 2, in place, per cubic yard.....cubic yards	1,650	6.75	11,137.50	5.64	9,306.00	6.13	10,114.50
Concrete No. 3, in place, per cubic yard.....cubic yards	650	9.00	5,850.00	8.00	5,200.00	9.00	5,850.00
Quarry grout, per cubic yard...do	2,800	2.50	7,000.00	.75	2,100.00	1.40	3,920.00
Broken stone (not in concrete), in place, per cubic yard.....cubic yards	370	2.80	1,036.00	.75	277.50	1.40	518.00
Steel beams, channels, etc., in place, per pound.....pounds	50,000	.03½	1,750.00	.03	1,500.00	.03	1,500.00
Steel trolley rails and trolleys, in place, per pound.....pounds	10,000	.10	1,000.00	.10	1,000.00	.15	1,500.00
Brass tubing, per linear foot..linear ft	175	.50	87.50	.50	87.50	.40	70.00
Castings for drain covers, rings, etc., per pound.....pounds	2,220	.06	132.00	.03	66.00	.02	44.00
Vitrified sewer pipe, in place, including traps, elbows, etc.:							
12-inch, in place, per linear foot, linear feet	190	.60	114.00	.50	95.00	.85	161.50
8-inch, in place, per linear foot, linear feet	200	.40	80.00	.40	80.00	.60	120.00
4-inch, in place, per linear foot, linear feet	250	.30	75.00	.30	75.00	.40	100.00
4-inch, cement pipe, in place, per linear foot.....linear feet	36	.30	10.80	.50	18.00	.40	14.40
Steel bolts, with plates and nuts, in place, per pound.....pounds	9,840	.06	590.40	.08	787.20	.03½	344.40
Iron ladders, in place, each	2	25.00	50.00	25.00	50.00	16.00	32.00
Iron railings, in place, per set...sets	2	60.00	120.00	50.00	100.00	100.00	200.00
Ammunition cranes, complete, in place, per crane	4	175.00	700.00	125.00	500.00	335.00	1,340.00
Ammunition lifts, complete, in place, per lift	2	500.00	1,000.00	750.00	1,500.00	1,400.00	2,800.00
Doors, in place, per pound...pounds	10,000	.12	1,200.00	.08	800.00	.08	800.00
Artesian well, including lining, per foot depth.....feet	100	6.00	600.00	7.50	750.00	6.50	650.00
Steam pump and boiler	1	700.00	700.00	350.00	350.00	313.00	313.00
Total for emplacements			69,558.20		55,065.20		63,229.30
Wharf and roadway:							
Split granite for dry rubble wall, in place, per ton of 2,000 pounds, tons	1,400	3.00	4,200.00	3.50	4,900.00	2.50	3,500.00
Rubble masonry in Portland cement mortar, in place, per cubic yard.....cubic yards	90	6.00	540.00	6.00	540.00	5.00	450.00
Coping stone (granite), in place, per ton of 2,000 pounds....tons	84	4.50	378.00	4.50	378.00	5.00	420.00
Quarry grout, for filling pier and roadway, wharf to shore, in place, per cubic yard, cubic yards	5,000	1.75	8,750.00	1.50	7,500.00	1.38	6,900.00
Excavation of road and ditch, battery to shore, including preparation of roadbed, in place, per cubic yard.....cubic yards	4,400	.80	3,520.00	1.00	4,400.00	.75	3,300.00
Oak fender piles, in place, each	11	10.00	110.00	10.00	110.00	10.00	110.00
Oak belaying posts, in place, each	4	8.00	32.00	10.00	40.00	10.00	40.00
Total for wharf and roadway			17,530.00		17,868.00		14,720.00
Total for emplacements, wharf, and roadway			87,088.20		72,933.20		77,949.30
Commence work		30 days after award.		Apr. 1, 1897.		Mar. 15, 1897.	
Complete work		Dec. 1, 1897.		Dec. 1, 1897.		Dec. 1, 1897.	

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Abstracts of proposals for construction of gun emplacements, Portland Harbor, Maine, opened at Portland, Me., February 18, 1897, etc.—Continued.

Items.	Approximate quantities.	4. M. I. Fenton & Co., New York, N. Y.		5. Clark & Co., New York, N. Y.		6. T. W. Kinser & Son, Terre Haute, Ind.	
		Price.	Amount.	Price.	Amount.	Price.	Amount.
Earth excavation (including the removal of woods), per cubic yard, cubic yards	2,800	$0.50	$1,400.00	$1.00	$2,800.00	$0.50	$1,400.00
Rock excavation, in place, per cubic yard.....cubic yards..	7,250	1.50	10,875.00	2.00	14,500.00	1.90	13,775.00
Earth fill, per cubic yard.....do....	1,000	.50	500.00	.30	300.00	.50	500.00
Bricks, in place, per thousand.....	10,000	20.00	200.00	19.00	190.00	20.00	200.00
Concrete No. 1, in place, per cubic yard.....cubic yards..	5,700	4.00	22,800.00	3.72	21,204.00	3.50	19,950.00
Concrete No. 2, in place, per cubic yard.....cubic yards..	1,650	5.50	9,075.00	7.00	11,550.00	5.50	9,075.00
Concrete No. 3, in place, per cubic yard.....cubic yards..	650	10.00	6,500.00	10.00	6,500.00	10.00	6,500.00
Quarry grout, per cubic yard....do....	2,800	1.00	2,800.00	2.25	6,300.00	.70	1,960.00
Broken stone (not in concrete), in place, per cubic yard.....cubic yards..	370	2.50	925.00	1.00	370.00	1.00	370.00
Steel beams, channels, etc., in place, per pound.....pounds..	50,000	.03½	1,750.00	.06	3,000.00	.03	1,500.00
Steel trolleyrails and trolleys, in place, per pound.....pounds..	10,000	.10	1,000.00	.08	800.00	.10	1,000.00
Brass tubing, per linear foot..linear ft..	175	.50	87.50	.50	87.50	.20	35.00
Castings for drain covers, rings, etc., per pound.....pounds..	2,200	.05	120.00	.02½	55.00	.05	110.00
Vitrified sewer pipe, in place, including traps, elbows, etc.:							
12-inch, in place, per linear foot, linear feet.....	190	.60	114.00	.60	114.00	.50	95.00
8-inch, in place, per linear foot, linear feet.....	200	.50	100.00	.50	100.00	.40	80.00
4-inch, in place, per linear foot, linear feet.....	250	.40	100.00	.40	100.00	.30	75.00
4-inch, cement pipe, in place, per linear foot.....linear feet..	36	.40	14.40	.40	14.40	.30	10.80
Steel bolts, with plates and nuts, in place, per pound.....pounds..	9,840	.05	492.00	.04	393.60	.05	492.00
Iron ladders, in place, each.....	2	50.00	100.00	10.00	20.00	30.00	60.00
Iron railings, in place, per set...sets..	2	100.00	200.00	20.00	40.00	30.00	60.00
Ammunition cranes, complete, in place, per crane.....	4	200.00	800.00	150.00	600.00	100.00	400.00
Ammunition lifts, complete, in place, per lift.....	2	850.00	1,700.00	600.00	1,200.00	600.00	1,200.00
Doors, in place, per pound...pounds..	10,000	.09	900.00	.04	400.00	.10	1,000.00
Artesian well, including lining, per foot depth.....feet..	100	12.00	1,200.00	12.00	1,200.00	8.00	800.00
Steam pump and boiler.....	1	1,000.00	1,000.00	500.00	500.00	700.00	700.00
Total for emplacements.....	.....	.....	64,752.90	.....	72,338.50	.....	61,347.80
Wharf and roadway:							
Split granite for dry rubble wall, in place, per ton of 2,000 pounds, tons.....	1,400	3.00	4,200.00	2.25	3,150.00	2.75	3,850.00
Rubble masonry in Portland cement mortar, in place, per cubic yard.....cubic yards..	90	4.00	360.00	5.00	450.00	5.75	517.50
Coping stone (granite), in place, per ton of 2,000 pounds....tons..	84	5.00	420.00	4.00	336.00	3.00	252.00
Quarry grout, for filling pier and roadway, wharf to shore, in place, per cubic yard, cubic yards	5,000	1.50	7,500.00	1.63	8,150.00	.50	2,500.00
Excavation of road and ditch, battery to shore, including preparation of roadbed, in place, per cubic yard.....cubic yards..	4,400	1.00	4,400.00	.50	2,200.00	.75	3,300.00
Oak fender piles, in place, each....	11	10.00	110.00	16.00	176.00	10.00	110.00
Oak belaying posts, in place, each..	4	12.00	48.00	12.00	48.00	25.00	100.00
Total for wharf and roadway....	.....	.....	17,038.00	.....	14,510.00	.....	10,629.50
Total for emplacements, wharf, and roadway	.....	.....	81,790.90	.....	86,848.50	.....	71,977.30
Commence work.....	.....	30 days after award.		Apr. 1, 1897.		Apr. 1, 1897.	
Complete work.....	.....	Dec. 1, 1897.		Nov. 30, 1897.		Dec. 1, 1897.	

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Abstracts of proposals for construction of gun emplacements, Portland Harbor, Maine, opened at Portland, Me., February 18, 1897, etc.—Continued.

Items.	Approximate quantities.	7. Mairs & Lewis, New York, N. Y.		8. Gardner C. Luther, Providence, R. I.		9. Maurier & Brownee, Brooklyn, N. Y.	
		Price.	Amount.	Price.	Amount.	Price.	Amount.
Earth excavation (including the removal of woods), per cubic yard, cubic yards	2,800	$0.30	$840.00	$0.60	$1,680.00	$0.30	$840.00
Rock excavation, in place, per cubic yard.....cubic yards	7,250	1.50	10,875.00	1.25	9,062.50	1.56	11,310.00
Earth fill, per cubic yard.....do	1,000	.30	300.00	.35	350.00	.30	300.00
Bricks, in place, per thousand	10,000	15.00	150.00	18.00	180.00	20.00	200.00
Concrete No. 1, in place, per cubic yard.....cubic yards	5,700	3.75	21,375.00	4.25	24,225.00	4.50	25,650.00
Concrete No. 2, in place, per cubic yard.....cubic yards	1,650	5.75	9,487.50	6.00	9,900.00	7.50	12,375.00
Concrete No. 3, in place, per cubic yard.....cubic yards	650	9.50	6,175.00	8.00	5,200.00	7.50	4,875.00
Quarry grout, per cubic yard....do	2,800	.65	1,820.00	1.50	4,200.00	1.25	3,500.00
Broken stone (not in concrete), in place, per cubic yard.....cubic yards	370	1.00	370.00	1.25	462.50	1.88	695.60
Steel beams, channels, etc., in place, per pound.....pounds	50,000	.03	1,500.00	.02½	1,375.00	.03½	1,875.00
Steel trolley rails and trolleys, in place, per pound.....pounds	10,000	.07	700.00	.10	1,000.00	.10	1,000.00
Brass tubing, per linear foot..linear ft	175	.30	52.50	.40	70.00	.30	52.50
Castings for drain covers, rings, etc., per pound.....pounds	2,200	.04	88.00	.03	66.00	.03½	82.50
Vitrified sewer pipe, in place, including traps, elbows, etc.:							
12-inch, in place, per linear foot, linear feet	190	.40	76.00	.50	95.00	.50	95.00
8-inch, in place, per linear foot, linear feet	200	.30	60.00	.50	100.00	.40	80.00
4-inch, in place, per linear foot, linear feet	250	.20	50.00	.25	62.50	.30	75.00
4-inch cement pipe, in place, per linear foot .....linear feet	36	.25	9.00	.20	7.20	530	10.80
Steel bolts, with plates and nuts, in place, per pound.....pounds	9,840	.05	492.00	.03¾	369.00	.06½	639.60
Iron ladders, in place, each	2	25.00	50.00	18.00	36.00	12.50	25.00
Iron railings, in place, per set...sets	2	50.00	100.00	37.50	75.00	30.00	60.00
Ammunition cranes, complete, in place, per crane	4	125.00	500.00	100.00	400.00	125.00	500.00
Ammunition lifts, complete, in place, per lift	2	750.00	1,500.00	1,000.00	2,000.00	250.00	500.00
Doors, in place, per pound...pounds	10,000	.04	400.00	.10	1,000.00	.10	1,000.00
Artesian well, including lining, per foot depth.....feet	100	10.00	1,000.00	6.00	600.00	12.50	1,250.00
Steam pump and boiler	1	1,000.00	1,000.00	600.00	600.00	837.00	837.00
Total for emplacements			58,970.00		63,115.70		67,828.00
Wharf and roadway:							
Split granite for dry rubble wall, in place, per ton of 2,000 pounds, tons	1,400	2.50	3,500.00	2.50	3,500.00	3.75	5,250.00
Rubble masonry in Portland cement mortar, in place, per cubic yard.....cubic yards	90	5.00	450.00	6.00	540.00	7.50	675.00
Coping stone (granite), in place, per ton of 2,000 pounds....tons	84	4.00	336.00	3.00	252.00	9.38	787.92
Quarry grout, for filling pier and roadway, wharf to shore, in place, per cubic yard, cubic yards	5,000	1.00	5,000.00	1.00	5,000.00	1.88	9,400.00
Excavation of road and ditch, battery to shore, including preparation of roadbed, in place, per cubic yard .....cubic yards	4,400	.75	3,300.00	1.00	4,400.00	.62	2,728.00
Oak fender piles, in place, each	11	10.00	110.00	10.00	110.00	25.00	275.00
Oak belaying posts, in place, each	4	10.00	40.00	6.00	24.00	15.00	60.00
Total for wharf and roadway			12,736.00		13,826.00		19,175.92
Total for emplacements, wharf, and roadway			71,706.00		76,941.70		87,003.92
Commence work		10 days after award.		30 days after award.		30 days after award.	
Complete work		Nov. 1, 1897.		Dec. 1, 1897.		Dec. 1, 1897.	

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Abstracts of proposals for construction of gun emplacements, Portland Harbor, Maine, opened at Portland, Me., February 18, 1897, etc.—Continued.

Items.	Approximate quantities.	10. The Hartford Paving and Construction Co., Hartford, Conn.		11. Chas. A. Trumbull, Boston, Mass.		12. Hamilton & Cleaves, Portland, Me.		13. W. S. White, Rockland, Me.	
		Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.
Earth excavation (including the removal of woods), per cubic yard.....cubic yards..	2,800	$0.40	$1,120.00	.....	.....	.....	.....	.....	.....
Rock excavation, in place, per cubic yard.....cubic yards..	7,250	.76	5,510.00	.....	.....	.....	.....	.....	.....
Earth fill, per cubic yard..do....	1,000	.35	350.00	.....	.....	.....	.....	.....	.....
Bricks, in place, per thousand...	10,000	12.00	120.00	.....	.....	.....	.....	.....	.....
Concrete No. 1, in place, per cubic yard.....cubic yards..	5,700	4.45	25,365.00	.....	.....	.....	.....	.....	.....
Concrete No. 2, in place, per cubic yard.....cubic yards..	1,650	5.70	9,405.00	.....	.....	.....	.....	.....	.....
Concrete No. 3, in place, per cubic yard.....cubic yards..	650	9.30	6,045.00	.....	.....	.....	.....	.....	.....
Quarry grout, per cubic yard, cubic yards	2,800	.73	2,044.00	.....	.....	.....	.....	.....	.....
Broken stone (not in concrete), in place, per cubic yard, cubic yards	370	.95	351.50	.....	.....	.....	.....	.....	.....
Steel beams, channels, etc., in place, per pound.....pounds..	50,000	.03	1,500.00	.....	.....	.....	.....	.....	.....
Steel trolley rails and trolleys, in place, per pound...pounds..	10,000	.11	1,100.00	.....	.....	.....	.....	.....	.....
Brass tubing, per linear foot, linear feet.....	175	.12	21.00	.....	.....	.....	.....	.....	.....
Castings for drain covers, rings, etc., per pound.....pounds..	2,220	.03	66.00	.....	.....	.....	.....	.....	.....
Vitrified sewer pipe, in place, including traps, elbows, etc.:									
12-inch, in place, per linear foot.....linear feet..	190	.38	72.20	.....	.....	.....	.....	.....	.....
8-inch, in place, per linear foot.....linear feet..	200	.25	50.00	.....	.....	.....	.....	.....	.....
4-inch, in place, per linear foot.....linear feet..	250	.18	45.00	.....	.....	.....	.....	.....	.....
4-inch, cement pipe, in place, per linear foot, linear feet..	36	.15	5.40	.....	.....	.....	.....	.....	.....
Steel bolts, with plates and nuts, in place, per pound...pounds..	9,840	.05	492.00	.....	.....	.....	.....	.....	.....
Iron ladders, in place, each.....	2	7.50	15.00	.....	.....	.....	.....	.....	.....
Iron railings, in place, per set, sets	2	24.00	48.00	.....	.....	.....	.....	.....	.....
Ammunition cranes, complete, in place, per crane.....	4	135.00	540.00	.....	.....	.....	.....	.....	.....
Ammunition lifts, complete, in place, per lift.....	2	740.00	1,480.00	.....	.....	.....	.....	.....	.....
Doors, in place, per pound, pounds.....	10,000	.05	500.00	.....	.....	.....	.....	.....	.....
Artesian well, including lining, per foot depth.....feet..	100	8.00	800.00	.....	.....	.....	.....	.....	.....
Steam pump and boiler	1	297.00	297.00	.....	.....	.....	.....	.....	.....
Total for emplacements...	.....	.....	57,342.10	.....	.....	.....	.....	.....	.....
Wharf and roadway:									
Split granite for dry rubble wall, in place, per ton of 2,000 pounds.....tons..	1,400	.....	.....	$3.50	$4,900.00	$2.75	$3,850.00	$2.25	$3,150.00
Rubble masonry in Portland cement mortar, in place, per cubic yard, cubic yards.....	90	.....	.....	7.50	675.00	6.00	540.00	4.50	405.00
Coping stone (granite), in place, per ton of 2,000 pounds .....tons..	84	.....	.....	4.00	336.00	3.00	252.00	3.00	252.00
Quarry grout, for filling pier and roadway, wharf to shore, in place, per cubic yard.....cubic yards..	5,000	.....	.....	2.37	11,850.00	2.90	14,500.00	1.15	5,750.00
Excavation of road and ditch, battery to shore, including preparation of roadbed, in place, per cubic yard...cubic yards..	4,400	.....	.....	1.00	4,400.00	1.29	5,676.00	.75	3,300.00
Oak fender piles, in place, each.....	11	.....	.....	20.00	220.00	15.00	165.00	8.00	88.00

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Abstracts of proposals for construction of gun emplacements, Portland Harbor, Maine, opened at Portland, Me., February 18, 1897, etc.—Continued.

Items.	Approximate quantities.	10. The Hartford Paving and Construction Co., Hartford, Conn.		11. Chas. A. Trumbull, Boston, Mass.		12. Hamilton & Cleaves, Portland, Me.		13. W. S. White, Rockland, Me.	
		Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.
Wharf and roadway—Cont'd. Oak belaying posts, in place, each	4			$20.00	$80.00	$15.00	$60.00	$5.00	$20.00
Total for wharf and roadway					22,461.00		25,043.00		12,965.00
Total for emplacements, wharf, and roadway									
Commence work		Apr. 1, 1897		Apr. 1, 1897		Apr. 20, 1897		July 1, 1897	
Complete work		Nov. 15, 1897		July 15, 1897		Aug. 20, 1897		Apr. 1, 1897	

List of contracts in force during fiscal year 1897.

Name of contractor: William Morgan.
Date of contract: March 2, 1897.
Date of approval: March 16, 1897.
Time of commencement: April 1, 1897.
Time for completion: December 1, 1897.

Name of contractor: T. W. Kinser & Sons.
Date of contract: March 6, 1897.
Date of approval: March 24, 1897.
Time of commencement: April 1, 1897.
Time for completion: December 1, 1897.

For details and prices of work under above contracts see abstract of proposals opened February 18, 1897.

Portsmouth Harbor, New Hampshire; two 8-inch gun emplacements and a mining casemate.—A contract for the construction of two emplacements for the 8-inch guns was entered into on December 30, 1896, and work was commenced on the 14th of April, 1897, and is now in operation. The rate of progress has not been such as the contract requires, and the contractors' attention has been called to the matter. It is promised that arrangements will be immediately made for working a double shift of men, giving 16 hours' work each day. The date fixed for completion of contract is October 15, 1897.

The following tabulated statement shows the situation on June 30, 1897:

Designation.	Estimated quantity.	Work done.	Remaining to be done June 30, 1897.
	Cubic yards.	*Cubic yards.*	*Cubic yards.*
Earth excavation	1,100	710	390
Ledge excavation	9,000	2,090	6,910
Earth embankment	6,800		6,800
Concrete	7,025		7,025
Beams, trolleys, etc.			All.

In addition to the work included in the above table, the contractors have repaired the old wharf. The force employed has been between 50 and 60 men.

The light keeper's dwelling, which stood upon the site selected for the emplacements, was moved to a new location, at a cost of $985.

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Under small allotments for preservation and repair, slight repairs have been made to the office building and the fences repaired and extended.

Money statements.

GUN AND MORTAR BATTERIES.

For contingencies and engineering:	
Allotments of February 5, March 11 and 27, 1897	$3,150.00
June 30, 1897, amount expended during fiscal year	461.20
July 1, 1897, balance unexpended	2,688.80
July 1, 1897, outstanding liabilities	1,135.00
July 1, 1897, balance available	1,553.80
For contract work:	
Allotment of March 27, 1897	50,000.00
July 1, 1897, amount covered by uncompleted contracts	50,000.00

TORPEDOES FOR HARBOR DEFENSE.

Allotment of April 27, 1897	$1,000.00
July 1, 1897, balance available	1,000.00

Abstracts of proposals for construction of gun emplacements at Portsmouth, N. H., opened at Portland, Me., December 10, 1896, by Lieut. Col. A. N. Damrell, Corps of Engineers.

Items.	Approximate quantities.	1. Mairs & Lewis, 18 Broadway, New York.		2. Clark & Co., 100 Broadway, New York.		3. Gardner C. Luther, Providence, R. I.	
		Price.	Amount.	Price.	Amount.	Price.	Amount.
1. Excavation, earth....cubic yards..	100	$0.30	$30.00	$2.10	$210.00	$1.25	$125.00
2. Excavation, ledge.....do...	9,000	1.20	10,800.00	2.10	18,900.00	1.50	13,500.00
3. Embankment.....do...	6,800	.40	2,720.00	.30	2,040.00	1.35	9,180.00
4. Natural cement concrete.....do...	6,860	4.85	33,271.00	4.00	27,440.00	4.00	27,440.00
5. Portland cement concrete....do...	165	7.50	1,237.50	12.00	1,980.00	8.00	1,320.00
6. Steel beams, channels, etc....lbs..	35,000	.03	1,050.00	.05	1,750.00	.03	1,050.00
7. Anchor bolts.....sets..	2	280.00	560.00	340.00	680.00	400.00	800.00
8. Trolleys.....do...	2	380.00	760.00	500.00	1,000.00	405.00	810.00
9. Doors, single.....number...	10	40.00	400.00	18.00	180.00	10.00	100.00
10. Doors, double.....do...	4	85.00	340.00	36.00	144.00	20.00	80.00
11. Bricks.....	10,000	15.00	150.00	26.00	260.00	20.00	200.00
12. 6-inch vitrified pipe.....feet..	140	.50	70.00	.40	56.00	.22	30.80
13. 8-inch vitrified pipe.....do...	225	.75	168.75	.45	101.25	.38	85.50
14. 4-inch cast-iron pipe.....do...	160	.50	80.00	.60	96.00	.50	80.00
15. Basin heads and gratings.....lbs..	2,000	.03¾	75.00	.05	100.00	.03	60.00
16. Cranes.....number..	8	190.00	1,520.00	60.00	480.00	130.00	1,040.00
17. Electric lighting, complete plant...	1	6,000.00	*6,000.00	5,500.00	5,500.00	3,500.00	3,500.00
18. Railings for platforms.....sets..	2	200.00	400.00	50.00	100.00	130.00	260.00
19. Iron ladders.....do...	2	80.00	160.00	60.00	120.00	20.00	40.00
20. Iron steps to platforms.....do ..	4	600.00	2,400.00	100.00	400.00	750.00	3,000.00
21. Iron steps to observation station, set.....	1	100.00	100.00	60.00	60.00	900.00	900.00
22. Speaking tubes.....feet..	100	.25	25.00	.30	30.00	.15	15.00
23. Quarry stone in concrete mass as required, per cubic yard.....	.....	3.00	.....	2.30	.....	1.50	.....
Amount.....	.....	.....	62,317.25	.....	61,627.25	.....	63,616.30
Time of beginning.....	.....	Feb. 1, 1896.		Mar. 1, 1897.		Jan. 1, 1897.	
Time of completion.....	.....	Sept. 1, 1897.		Sept. 15, 1897.		Jan. 1, 1898.	

*100 lights 12 hours, $4,000; 100 lights 6 hours, $2,000.

Ammunition lifts, each $600; new wharf, complete, $1,000.

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Abstracts of proposals for construction of gun emplacements at Portsmouth, N. H., opened at Portland, Me., December 10, 1896, etc.—Continued.

Items.	Approximate quantities.	4. Manhattan Concrete Compnay, New York.		5. A. W. Bryne Construction Company, West Medford, Mass.		6. Hartford Paving and Construction Company, Hartford, Conn.	
		Price.	Amount.	Price.	Amount.	Price.	Amount.
1. Excavation, earth....cubic yards..	100	$0.56	$56.00	$0.40	$40.00	$0.35	$35.00
2. Excavation, ledge.....do...	9,000	1.64	14,760.00	3.50	31,500.00	.74	6,660.00
3. Embankment.....do...	6,800	.81	5,508.00	1.25	8,500.00	.70	4,760.00
4. Natural cement concrete.....do...	6,860	4.86	33,339.60	5.00	34,300.00	4.65	31,899.00
5. Portland cement concrete....do...	165	8.50	1,402.50	9.00	1,485.00	*5.74 †7.95	1,028.43
6. Steel beams, channels, etc.....lbs..	35,000	.03¾	1,312.50	.04	1,400.00	.03⅛	1,225.00
7. Anchor bolts.....sets..	2	250.00	500.00	150.00	300.00	155.00	310.00
8. Trolleys.....do...	2	205.00	410.00	400.00	800.00	497.00	994.00
9. Doors, single.....nnmber..	10	36.00	360.00	25.00	250.00	9.50	95.00
10. Doors, double.....do...	4	50.00	200.00	40.00	160.00	12.16	48.64
11. Bricks.....	10,000	20.00	200.00	30.00	300.00	12.00	120.00
12. 6-inch vitrified pipe.....feet..	140	.38	53.20	1.00	140.00	.22	30.80
13. 8-inch vitrified pipe.....do...	225	.45	101.25	1.00	225.00	.27	60.75
14. 4-inch cast-iron pipe.....do...	160	.50	80.00	1.50	240.00	.54	86.40
15. Basin heads and gratings....lbs...	2,000	.04	80.00	.03	60.00	.03	60.00
16. Cranes.....number..	8	58.00	464.00	75.00	600.00	78.00	624.00
17. Electric lighting, complete plant...	1	4,500.00	4,500.00	7,500.00	7,500.00	6,800.00	6,800.00
18. Railings for platforms.....sets..	2	100.00	200.00	50.00	100.00	23.00	46.00
19. Iron ladders.....do...	2	22.00	44.00	100.00	200.00	7.25	14.50
20. Iron steps to platforms.....do...	4	180.00	720.00	100.00	400.00	95.00	380.00
21. Iron steps to observation station, set.....	1	180.00	180.00	100.00	100.00	85.00	85.00
22. Speaking tubes.....feet..	100	.30	30.00	.20	20.00	.10	10.00
23. Quarry stone in concrete mass as required, per cubic yard.....	.....	1.10	.....	1.50	.....	.59	.....
Amount.....	.....	.....	64,501.05	.....	88,620.00	.....	55,372.52
Time of beginning.....	.....	Feb. 1, 1897.		Jan. 1, 1896.		Apr. 15, 1897.	
Time of completion.....	.....	Dec. 1, 1897.		Oct. 1, 1896.		Oct. 15, 1897.	

Items.	Approximate quantities.	7. Molloy & Sheehan, New Rochelle, N. Y.		8. T. W. Kinser & Sons, Waltham, Mass.		9. H. C. Moore, New York.	
		Price.	Amount.	Price.	Amount.	Price.	Amount.
1. Excavation, earth....cubic yards..	100	$0.50	$50.00	$0.50	$50.00	$0.50	$50.00
2. Excavation, ledge.....do...	9,000	1.65	14,850.00	2.50	22,500.00	1.10	9,900.00
3. Embankment.....do...	6,800	1.00	6,800.00	1.00	6,800.00	.40	2,720.00
4. Natural cement concrete.....do...	6,760	4.85	33,271.00	4.70	32,242.00	4.85	33,271.00
5. Portland cement concrete.....do...	165	6.00	990.00	10.00	1,650.00	8.00	1,320.00
6. Steel beams, channels, etc.....lbs..	35,000	.03	1,050.00	.03	1,050.00	.02¾	962.50
7. Anchor bolts.....sets..	2	225.00	450.00	20.00	40.00	100.00	200.00
8. Trolleys.....do...	2	600.00	1,200.00	300.00	600.00	500.00	1,000.00
9. Doors, single.....number..	10	25.00	250.00	15.00	150.00	29.00	290.00
10. Doors, double.....do...	4	40.00	160.00	30.00	120.00	60.00	240.00
11. Bricks.....	10,000	18.00	180.00	25.00	250.00	20.00	200.00
12. 6-inch vitrified pipe.....feet..	140	.60	84.00	1.00	140.00	.20	28.00
13. 8-inch vitrified pipe.....do...	225	.80	180.00	1.00	225.00	.25	56.25
14. 4-inch cast-iron pipe.....do...	160	.40	64.00	.30	48.00	.60	96.00
15. Basin heads and gratings.....lbs..	2,000	.05	100.00	.05	100.00	.05	100.00
16. Cranes.....number..	8	250.00	2,000.00	100.00	800.00	200.00	1,600.00
17. Electric lighting, complete plant...	1	7,900.00	7,900.00	7,000.00	7,000.00	3,000.00	3,000.00
18. Railings for platforms.....sets..	2	25.00	50.00	100.00	200.00	50.00	100.00
19. Iron ladders.....do...	2	40.00	80.00	20.00	40.00	20.00	40.00
20. Iron steps to platforms.....do...	4	300.00	1,200.00	100.00	400.00	50.00	200.00
21. Iron steps to observation station, set.....	1	100.00	100.00	150.00	150.00	50.00	50.00
22. Speaking tubes.....feet..	100	.25	25.00	.10	10.00	1.00	100.00
23. Quarry stone in concrete mass as required, per cubic yard.....	.....	1.50	.....	2.00	.....	1.20	.....
Amount.....	.....	.....	71,034.00	.....	74,565.00	.....	55,523.25
Time of beginning.....	.....	Mar. 1, 1897.		Feb. 1, 1897.		Mar. 1, 1897.	
Time of completion.....	.....	Dec. 1, 1897.		Nov. 1, 1897.		Nov. 1, 1897.	

*130 cubic yards, at $5.74 per cubic yard.
†35 cubic yards, at $7.95 per cubic yard.

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Abstracts of proposals for construction of gun emplacements at Portsmouth, N. H., opened at Portland, Me., December 10, 1896, etc.—Continued.

Items.	Approximate quantities.	10. Scruton & Hett, Portsmouth, N. H.		11. Pennel & O'Brien, Yonkers, N. Y.		12. William Morgan, Trenton, N. J.	
		Price.	Amount.	Price.	Amount.	Price.	Amount.
1. Excavation, earth....cubic yards..	100	$0.43	$43.00	$0.40	$40.00	$1.00	$100.00
2. Excavation, ledge.....do...	9,000	3.18	28,620.00	2.00	18,000.00	3.00	27,000.00
3. Embankment.....do...	6,800	1.06	7,280.00	.50	3,400.00	1.25	8,500.00
4. Natural cement concrete.....do...	6,860	5.95	40,817.00	3.80	26,068.00	7.50	51,450.00
5. Portland cement concrete....do...	165	11.72	1,933.80	12.00	1,980.00	10.50	1,732.50
6. Steel beams, channels, etc. pounds..	35,000	.05	1,750.00	.04	1,400.00	.03½	1,225.00
7. Anchor bolts.....sets..	2	260.00	520.00	152.14	304.28	175.00	350.00
8. Trolleys.....do...	2	500.00	1,000.00	250.00	500.00	750.00	1,500.00
9. Doors, single.....number..	10	50.00	500.00	15.00	150.00	20.00	200.00
10. Doors, double.....do...	4	55.00	220.00	30.00	120.00	25.00	100.00
11. Bricks.....	10,000	24.00	240.00	30.00	300.00	18.00	180.00
12. 6-inch vitrified pipe.....feet..	140	1.10	154.00	1.50	210.00	.50	70.00
13. 8-inch vitrified pipe.....do...	225	1.15	258.75	1.50	337.50	.75	168.75
14. 4-inch cast-iron pipe.....do...	160	1.30	208.00	1.50	240.00	1.25	200.00
15. Basin heads and gratings, pounds..	2,000	.05	100.00	.04	80.00	.03	60.00
16. Cranes.....number..	8	136.00	1,088.00	50.00	400.00	250.00	2,000.00
17. Electric lighting, complete plant..	1	2,040.00	2,040.00	6,000.00	6,000.00	3,000.00	3,000.00
18. Railings for platforms.....sets..	2	27.00	54.00	25.00	50.00	25.00	50.00
19. Iron ladders.....do...	2	22.00	44.00	25.00	50.00	25.00	50.00
20. Iron steps to platforms.....do...	4	340.00	1,360.00	25.00	100.00	150.00	600.00
21. Iron steps to observation station, set.....	1	340.00	340.00	25.00	25.00	100.00	100.00
22. Speaking tubes.....feet..	100	.10	10.00	.15	15.00	.25	25.00
23. Quarry stone in concrete mass as required, per cubic yard.....	.....	2.00	.....	1.60	.....	1.50	.....
Amount.....	.....	.....	88,580.55	.....	59,769.78	.....	98,661.25
Time of beginning.....	.....	Feb. 1, 1897.		Before 10 days' notice expires.		Mar. 20, 1897.	
Time of completion.....	.....	Dec. 1, 1897.		Dec. 1, 1897.		Dec. 1, 1897.	

List of contracts in force during the fiscal year 1897.

Name of contractor, The Hartford Paving and Construction Company.
Date of contract, December 30, 1896.
Date of approval, February 1, 1897.
Time for commencement, April 15, 1897.
Time for completion, October 15, 1897.

For details and prices see abstract of bids opened December 10, 1896, except that electric-lighting plant is to be omitted.

3 B.

BOSTON HARBOR, MASSACHUSETTS.

Officer in charge, Lieut. Col. S. M. Mansfield, Corps of Engineers; assistants, Lieut. M. L. Walker, Corps of Engineers, from July 14 to December 29, 1896, and Lieut. J. S. Sewell, Corps of Engineers, since April 6, 1897.

Three emplacements for 10-inch rifles, disappearing carriages.—At the beginning of the fiscal year the condition of the work was as follows:

About 2,000 cubic yards of concrete were needed to complete one emplacement, of which the gun platform proper was completed and the base ring for the carriage was set. The masonry of the other two emplacements was completed, except about 500 cubic yards of concrete at the upper entrances of the lifts and in front of the gun positions. The platforms proper were so far advanced that the gun carriages could be mounted as soon as received.

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During the year the work has been essentially completed, there remaining to be done some little sodding and cleaning up about the batteries, the providing of ammunition carriers, ladders, and magazine doors, and the installation of an electric-light plant.

Two 10-inch disappearing carriages have been assembled, while the third carriage is about to be placed on the remaining platform.

Money statement.

July 1, 1896, balance available	$51,233.28
Expended during fiscal year	36,936.58
July 1, 1897, balance available	14,296.70

Five emplacements for 10-inch rifles, disappearing carriages.—At the beginning of the present fiscal year the condition of this work was as follows:

The masonry and covering earth embankments of the southern emplacement were essentially completed, except such parts as depended upon the elevation of the platform, or about 1,000 cubic yards of concrete to be put in. The rammed-earth foundation of the gun platform had been commenced.

Under date of June 30, 1896, it was proposed to construct three emplacements for 10-inch guns and two emplacements for 5-inch rapid-fire guns, and I was instructed to submit plans and estimates for the same at a cost not to exceed $158,000, a provisional allotment of $100,000 being made from the act of June 6, 1896, "Gun and mortar batteries," in order that the work might proceed without delay.

Detailed drawings and estimates were submitted September 22, 1896, and received general approval of the Chief of Engineers by indorsement dated October 2, 1896, as regards the emplacements for 10-inch guns. The arrangements proposed for the rapid-fire guns seeming to need revision, approval was withheld.

Natural obstacles to rapid progress, such as insufficient wharf facilities for the delivery of concrete material, contracted space on the work situated upon the top of a hill 100 feet high and occupied by a light-house establishment, the site of the battery itself over a battery of eleven 15-inch guns, and limited accommodations for laborers, made the work a trying one; nevertheless, I was able to report by the 31st of December the completion of four gun platforms, the masonry of emplacements Nos. 2 and 3, and intervening parapet carried to a level of 6 feet above the magazine ceiling, and the excavation of emplacement No. 4 well advanced toward completion.

Under date of April 6, 1897, Lieutenant-Colonel Mansfield was requested to submit detailed plans and estimates for one emplacement for one 10-inch gun on disappearing carriage, L. F. model 1896, this emplacement to complete the battery. The plan and estimate received the approval of the Chief of Engineers June 23, 1897, and an allotment of $45,000 was made from the appropriation for "Gun and mortar batteries," act of March 3, 1897.

The condition of the work on June 30, 1897, is as follows:

Emplacements Nos. 1, 2, and 3 are practically completed, so far as the parapet is concerned, and the excavation for emplacement No. 4 is nearly ready for concreting over all that portion occupied by the magazine and gun parapet. The portion to the west of the magazine is nearly ready for the concrete forms, and part of the excavation for the parapet of emplacement No. 5, is executed.

Four gun platforms are ready for carriages and guns, but no loading

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platforms or masonry construction of the interior of the battery has yet been attempted, and one casemate for a rapid-fire gun is completed with the exception of opening the port

No guns or carriages are on hand.

Money statement.

July 1, 1896, balance available	$29,181.43
Allotted since	197,200.00
	226,381.43
Expended during fiscal year	47,853.23
July 1, 1897, balance available	178,528.20

Mortar battery for sixteen 12-inch mortars.—On June 30, 1896, the battery was complete, except the concrete revetment of the southwest pit slopes, the ammunition carrier, and the electric lighting and firing plant.

During the fiscal year ending June 30, 1897, the concrete revetment of the southwest pit was placed, the ammunition carriers and cranes were provided, the electric lighting and firing plant installed, and surface drains in rear of the battery overhauled, and the battery completed in every particular. Sixteen mortars are mounted.

Under authority of the Acting Secretary of War, dated June 29, 1896, this battery was turned over to the commanding officer, Fort Warren, Mass., for use and care by the troops, under the provisions of paragraph 1486, Army Regulations, July 25, 1896, and is now in charge of an officer of artillery and small squad of soldiers.

The amounts of the allotments for this work were as follows:

Act of—		
August 18, 1890	$185,000.00	
August 18, 1890	4,300.00	
August 1, 1894	6,400.00	
February 18, 1893	10,000.00	
August 1, 1894	24,000.00	
August 1, 1894	6.40	
August 1, 1894	2,780.10	
		$232,486.50

From the allotments the following were withdrawn:

April 18, 1891	$63,960.73	
December 19, 1893	2,000.00	
February 18, 1896	8,729.65	
		74,690.38
Balance		157,796.12

Money statement.

July 1, 1896, balance available	$7,020.67
Expended during fiscal year	5,964.64
July 1, 1897, balance available	1,056.03

Cable tank.—Under instructions of the Chief of Engineers, August 14, 1896, detailed plans and estimate of a cable tank for use in the submarine defense of Boston Harbor were submitted on January 11, 1897.

The estimated cost is $4,263.87.

This was substantially approved, and $4,300 was allotted from the appropriation for "Torpedoes for Harbor Defense," act of June 6, 1896, by indorsement of the Chief of Engineers, dated January 13, 1897.

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Operations during the year upon the construction of the cable tank have only just begun, and only about one-fourth of the necessary excavation has been accomplished.

Money statement.

January 13, 1897, amount allotted	$4,300.00
Expended during fiscal year	41.04
July 1, 1897, balance available	4,258.96

Sites.—Under date of August 17, 1896, the officer in charge was requested to report the areas which he thought should be acquired as sites for works for the defense of Boston Harbor, to be located on land not now owned by the United States, as indicated in the approved project of The Board of Engineers, dated August 1, 1889; the names of the owners; the area owned by each owner; the improvements thereon, if any; the lowest price at which each owner will probably sell; whether such prices are considered by him reasonable, and whether, in his opinion, the sites should be purchased by agreement with the owners or should be acquired by condemnation.

Approximate estimates were telegraphed to the Department September 19, 1896, for use in Annual Report of the Chief of Engineers.

The purchase of two of the required sites was authorized by the Secretary of War, and negotiations are now in progress for their acquisition. It is expected that the title to one of these sites will shortly pass to the United States and enable the construction of a mortar battery for eight 12-inch mortars to be commenced. The plans of this battery have been approved and funds allotted.

Money statement.

Amount allotted during fiscal year	$284,378.85
Expended during fiscal year	1,248.85
July 1, 1897, balance available	283,130.00

3 C.

DEFENSES OF SOUTHEAST COAST OF MASSACHUSETTS AND RHODE ISLAND.

Officers in charge, Maj. D. W. Lockwood, Corps of Engineers, with First Lieut. C. H. McKinstry, Corps of Engineers, under his immediate orders; Division Engineer, Col. (now Brig. Gen.) John M. Wilson, Corps of Engineers, to February 11, 1897, and Col. G. L. Gillespie, Corps of Engineers, since that time.

Narragansett Bay.—Mortar battery for sixteen 12-inch mortars.—Under the provisions of the act for gun and mortar batteries, approved June 6, 1896, it is proposed to construct a sixteen 12-inch mortar battery, at a cost of not to exceed $125,000. Allotments have been made from said act as follows: July 24, 1896, $500 for preparation of plans and estimates; August 12, 1896, $20,000; September 19, 1896, $25,000, and October 7, 1896, $80,000 for constructing work.

Under date of June 30, 1896, the Chief of Engineers directed that plans and estimates in detail looking to the completion of all engineer department work in connection with the battery, including a relocator

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room, observation station, electric-light plant, ammunition storage and supply, etc., be prepared and submitted, and that the work be so carried on as to complete it by July 1, 1897. Under date of September 9, 1896, instructions were received to so arrange the work that, if possible, the platforms would be ready by December 1, 1896. Under date of August 29, 1896, the plans called for, with estimates, were submitted. On September 18, 1896, a revised estimate, with plan and cross sections showing the battery raised 2 feet, was submitted, and approved under date of September 30, 1896.

The following contracts were entered into: With Mr. Jeremiah K. Sullivan, of Newport, R. I., dated September 26, 1896, approved October 3, 1896, for furnishing sand at the rate of $1.25 per cubic yard; with Brown & Howard, of Newport, R. I., dated September 28, 1896, approved October 3, 1896, for furnishing broken stone at $1.81 per cubic yard; with the Lawrenceville Cement Company, of New York, N. Y., dated October 2, 1896, approved October 20, 1896, for furnishing American Rosendale cement at 85 cents per barrel, and with the Atlas Cement Company, of New York, N. Y., dated November 5, 1896, approved November 12, 1896, for furnishing American Portland cement at $2.12 per barrel.

All necessary plant has been assembled and is in working order, viz, railroad for handling cement, sand, lumber, etc., from dock to site of work, concrete mixer, sectional track for delivering concrete, three derricks, etc.

This work was in the local charge of First Lieut. C. H. McKinstry, Corps of Engineers, and for details of work done during the past year attention is invited to his report, appended hereto.

Money statement.

Amount allotted during fiscal year		$125,500.00
June 30, 1897, amount expended during fiscal year		52,736.15
July 1, 1897, balance unexpended		72,763.85
July 1, 1897, outstanding liabilities	$13,061.43	
July 1, 1897, amount covered by uncompleted contracts	12,730.34	
		25,791.77
July 1, 1897, balance available		46,972.08

Abstract of proposals received and opened September 15, 1896, by Maj. D. W. Lockwood, Corps of Engineers, for furnishing cement, broken stone, and sand for use in construction of mortar battery.

No.	Name and address of bidder.	Class A. American Rosendale cement (13,500 barrels), per barrel.	Class B. Broken stone (7,500 cubic yards), per cubic yard.	Class C. Sand (4,500 cubic yards), per cubic yard.	Class D. American Portland cement (1,000 barrels), per barrel.
1	J. K. Sullivan, Newport, R. I.	.....	.....	$1.25	.....
2	Merrick L. Goff, Providence, R. I.*	$0.95	.....	.....	.....
3	Brown & Howard, Newport, R. I.	.....	$1.81	.....	.....
4	Atlas Cement Co., New York, N. Y.	.....	.....	.....	$2.12
5	Francis H. Smith, New York, N. Y.†	.....	1.70	1.40	.....
6	Lawrenceville Cement Co., New York, N. Y.‡	.85	.....	.....	.....

* Brooklyn Bridge brand. † Silica gravel. ‡ Beech's brand.

Contracts awarded as follows: Class A, Rosendale cement, to the Lawrenceville Cement Company; Class B, broken stone, to Brown & Howard; Class C, sand, to J. K. Sullivan; Class D, Portland cement, to the Atlas Cement Company.

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Contracts in force.

Contractors.	Nature of contract.	To commence.	To complete.
J. K. Sullivan	Furnishing sand	Oct. 15, 1896	When needed.
Brown & Howard	Furnishing stone	Oct. 10, 1896	Do.
Lawrenceville Cement Co.	Furnishing American Rosendale cement.	....do	Do.
Atlas Cement Co.	Furnishing American Portland cement.	Nov. 10, 1896	Do.

REPORT OF FIRST LIEUT. C. H. MCKINSTRY, CORPS OF ENGINEERS.

MAJOR: I have the honor to submit the following report of operations on mortar battery for the year ending June 30, 1897:

Plans and project for the battery were approved September 30, 1896.

Agreement under public notice was entered into August 17, 1896, with Mr. James Corrigan, of Newport R. I., to do the excavation necessary, some 20,000 cubic yards. It was proposed to do the further excavation required, namely, for the mortar pits, wall footings, drains, etc., in all some 3,000 yards, by hired labor. By the terms of the agreement the excavation was to be completed October 15, 1896. On January 16, 1897, the agreement was closed, 15,590 cubic yards having been taken out.

The excavation of the first mortar pit (No. 4) by hired labor was begun October 9. On December 22, when concrete work had to be suspended on account of freezing weather, six emplacements were ready for base rings. Work was resumed April 1, 1897. The condition of the work June 30 was as follows:

1. Excavation.—The excavation is completed except 10 cubic yards of rock in Pit No. 1, about 50 yards of rock south of Pit No. 1, about 40 yards of earth and rock north of Pit No. 1, and about 25 yards of earth in the roadway at the left flank of the battery. The following amounts of earth and rock have been removed by hired labor: Earth, 3,625 yards; rock, 1,060 yards.

2. Mortar platforms.—The excavation of Pit 1 is all but completed. The material is ledge rock. Emplacement not begun.

The emplacements in Pits 2, 3, and 4 are completed as far as and including the setting of the base rings. The inclined walls around Pit 4 are nearly completed.

The mortar platforms contain the following amounts of concrete: Portland cement concrete, 406 cubic yards; natural cement concrete, 755 cubic yards.

The cost of the Portland cement concrete up to December 31, 1896, at which time 113 cubic yards (1 to 2 to 4) had been placed, was $8.19 per cubic yard. The cost of the natural cement concrete, 506 cubic yards of which (1 to 2 to 4) had been placed, was $5.37 per cubic yard.

3. Walls, etc.—The walls about the rooms and passageways at the east end of the battery, those about and forward of Pits 4 and 3, and the south wall forward of Pit 2, were completed to the height of the roof. In addition to this the roof over the rooms and passage at the east end and over the magazine and shell rooms of Pit 4 were about two-thirds done.

In walls, footings, roof, pavements, etc., 4,595 cubic yards of natural cement concrete (1 to 2 to 5 and 1 to 2 to 4½) have been placed. The 992 cubic yards placed prior to December 31, 1896, cost $6.26 per cubic yard.

The concrete placed in walls, etc., since that time has cost more, on account of the greater cost of framing for roofs (under I-beams), for trolley tracks and for inclined walls. A precise determination of cost is deferred until the completion of the work.

Respectfully submitted.

C. H. MCKINSTRY,
First Lieut., Corps of Engineers, U. S. A.

Maj. D. W. LOCKWOOD,
Corps of Engineers, U. S. A.

Emplacements for three 10-inch guns on disappearing carriages.—Under the provisions of the act for gun and mortar batteries, approved June 6, 1896, it is proposed to construct by contract, a three 10-inch gun battery. Allotments have been made from said act as follows: September 17, 1896, $400 for preparation of plans and estimates; December 10, 1896, $8,000 for contingencies, and on April 23, 1897, $91,000 for payments to contractor only, from act of March 3, 1897.

Under dates of August 6, 1896, and September 11, 1896, the Chief of Engineers directed that plans and estimates in detail for emplacements for two 10-inch disappearing guns, be prepared and submitted, and said plans were submitted and approved in October, 1896. Proposals for this work were opened on October 24, 1896, and the contract for the construction of the gun battery was awarded to Mr. Richard M. Dudley, of New

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York City, at the rate of $56,967 for two emplacements. An additional emplacement was authorized by Department letter of December 10, 1896, and contract entered into under date of December 24, 1896, for three emplacements complete, and approved by the Chief of Engineers under date of January 6, 1897. A detailed survey of the site was made and platted in March, 1897. Plans and estimates for the three emplacements were prepared and submitted in April, 1897, and partially approved by the Chief of Engineers during the same month.

Two of the old magazines being directly within the line of fire their removal was determined on, and under date of May 4, 1897, a supplementary contract was entered into with the contractor for the removal of the two old magazines, two gun platforms, etc., in all about 1,000 cubic yards of material, at the rate of $1.75 per cubic yard.

This work was in the local charge of Mr. L. S. Johnson as inspector, and for details of work done during the past year attention is invited to his report appended hereto.

Money statement.

Amount allotted during fiscal year		$99,400.00
June 30, 1897, amount expended during fiscal year		10,472.87
July 1, 1897, balance unexpended		88,927.13
July 1, 1897, outstanding liabilities	$12,243.98	
July 1, 1897, amount covered by uncompleted contracts	70,752.54	
		82,996.52
July 1, 1897, balance available		5,930.61

Abstract of proposals received and opened November 24, 1896, by Maj. D. W. Lockwood, Corps of Engineers, for constructing gun battery.

Articles and class of work.	Approximate quantities for two emplacements.	The Manhattan Concrete Co., New York, N. Y.	Sooysmith & Co., New York, N. Y.	Richard M. Dudley, New York, N. Y.	Frank Pidgeon, Saugerties, N. Y.	John L. Grim, Philadelphia, Pa.	Hughes Bros. & Bangs, Syracuse, N. Y.
Excavation.....cubic yards..	7,000	$0.73	$1.50	$0.30	$0.85	$0.40	$0.40
Fill, earth .....do...	3,000	.31	.50	.25	.70	.30	.20
Loam .....do...	800	.31	1.00	.25	.80	.50	.20
Sod .....square yards..	2,350	.33	.40	.30	2.00	.40	.25
Broken stone.....cubic yards..	300	1.50	2.00	2.50	2.50	2.65	2.25
Concrete, natural cement..do...	6,200	7.10	7.00	5.40	7.00	5.85	6.37
American Portland:							
Ordinary.....do...	320	9.00	10.00	7.40	10.00	6.95	7.50
Granolithic .....do...	130	15.00	12.00	8.40	12.00	9.50	7.50
Facing.....do...	200	14.00	15.00	11.00	15.00	12.00	7.50
Stone in mass of concrete..tons..	3,500	1.15	3.00	1.90	2.00	2.35	1.50
I-beams (steel).....pounds..	33,000	.03	.03	.02½	.06	.02½	.03
Steel trolley beams and trolleys.....pounds..	12,000	.04	.10	.04	.10	.15	.15
Anchor bolts, nuts, and plates, pounds.....	4,300	.05	.03	.03½	.10	.05	.06
Lumber, white pine, for doors, feet B. M.....	1,300	.09	.07	.20	150.00	.10	80.00
Brass fittings for doors, pounds.....	1,800	.24	.40	.30	.50	.50	.40
White-pine strips (electrical conductors).....feet B. M..	600	.09	.10	.20	150.00	.07	50.00
Galvanized-iron pipe, 1¼-inch, with fittings.....feet..	302	.23	.04	.25	.30	.12	.20
Granite steps and curbing, cubic yards.....	10	50.00	60.00	27.00	40.00	50.00	50.00
Iron pipe, 4-inch.....feet...	130	.25	.20	.50	1.00	.35	.25
Sewer pipe, 8-inch, glazed..do...	385	.23	.20	.30	1.00	1.00	.25
Porous drain tile, 4-inch...do...	600	.20	.10	.08	.75	.65	.10
Brick for manholes.....M..	.....	20.00	20.00	20.00	30.00	18.00	15.00
Manhole covers.....	2	20.00	10.00	10.00	30.00	12.00	25.00
Stairs and hand rails.....	2	200.00	200.00	100.00	250.00	210.00	300.00
Double lifts (complete).....	2	500.00	1,000.00	3,400.00	2,000.00	1,800.00	1,600.00
Total amount of bids.....	.....	67,247.01	81,405.08	56,967.00	81,140.60	63,843.49	61,357.65

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Abstract of proposals received and opened November 24, 1896, etc.—Continued.

Articles and class of work.	Approximate quantities for two emplacements.	Edward W. Everson, Providence, R. I.	Joseph P. Cotton, Newport, R. I.	Wilson & Baillie Manufacturing Co., Brooklyn, N. Y.	Frederick E. Shaw, Providence, R. I.	Clark & Co., New York, N. Y.
Excavation.....cubic yards..	7,000	$1.35	$0.64	$0.70	$0.75	$1.40
Fill, earth.....do...	3,000	.30	.40	.25	.40	.60
Loam.....do...	800	.30	.53	1.50	.50	.35
Sod.....square yards..	2,350	.50	.32	.80	.30	.40
Broken stone.....cubic yards..	300	2.50	2.50	3.00	3.00	.75
Concrete, natural cement..do....	6,200	5.75	6.45	6.50	8.00	6.50
American Portland:						
Ordinary.....do...	320	7.00	8.73	9.00	10.00	8.50
Granolithic.....do...	130	9.50	11.00	17.00	13.00	12.00
Facing.....do...	200	12.00	17.00	17.00	18.00	14.00
Stone in mass of concrete..tons..	3,500	3.00	1.75	2.50	3.00	1.90
I-beams (steel).....pounds..	33,000	.03½	.04½	.04½	.03	.05½
Steel trolley beams and trolleys.....pounds..	12,000	.05	.08	.08	.08	.07
Anchor bolts, nuts, and plates, pounds.....	4,300	.05	.05½	.04	.10	.06
Lumber, white pine, for doors, feet B. M.....	1,300	.12	200.00	.15	.07	.10
Brass fittings for doors, pounds.....	1,800	.70	.27	.50	.50	.50
White-pine strips (electrical conductors).....feet B. M..	600	.12	.12	.15	.06	.10
Galvanized-iron pipe, 1¼-inch, with fittings.....feet..	302	.50	.13	.30	.15	.12
Granite steps and curbing, cubic yards.....	10	50.00	34.00	.50	30.00	50.00
Iron pipe, 4-inch.....feet..	130	2.00	.87	.45	.60	.60
Sewer pipe, 8-inch, glazed..do...	385	4.00	1.37	.80	.30	.30
Porous drain tile, 4-inch...do...	600	.30	.27	.40	.08	.15
Brick for manholes.....M..	.....	26.00	35.00	22.00	20.00	30.00
Manhole covers.....	2	15.00	15.00	25.00	12.00	14.00
Stairs and hand rails.....	2	500.00	327.00	200.00	175.00	70.00
Double lifts (complete).....	2	1,200.00	2,712.00	1,200.00	500.00	900.00
Total amount of bids.....	.....	62,385.00	69,539.41	73,346.10	81,932.80	72,995.74

Contract awarded to Richard M. Dudley for three emplacements.

Contract in force.

Contractor.	Date of approval.	To commence.	To complete.
Richard M. Dudley.....	Jan. 6, 1897	Feb. 1, 1897	Nov. 1, 1897

REPORT OF MR. L. S. JOHNSON, INSPECTOR.

MAJOR: I have the honor to submit the following report of operations on gun battery for the year ending June 30, 1897:

Ground was broken by the contractor's force on March 27, 1897, the following plant having been installed: One horizontal boiler, 1 upright boiler, 1 steam pump, 3 double hoists, 4 derricks, 1 rotary concrete mixer, 2 steam drills, 9 steel hoist buckets, 5 teams of heavy horses, with wagons, barrows, plow, scrapers, bars, and a general line of first-class tools, every piece of which was new and of good make. A cement shed of 3,000 barrels capacity was erected, the old buildings on the island being used as dormitories and mess rooms. The old artesian well was cleaned out and its pump repaired.

Excavation.—Active operations were commenced in April upon the excavation, and to June 30 7,082 cubic yards of material have been removed. The excavation for the masonry of Emplacement No. 3 is completed; for No. 2 is finished except for 4 feet of depth for the square occupied by magazine, shell room, and lift gallery. The earth has been removed to the rock, a depth of about 2 feet over Emplacement No. 1; that for roadway and slopes in rear of battery has not as yet been touched. About 6 feet of the excavation is in trap rock and quite difficult of removal. A very large proportion of the excavation is waste.

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At this date 352 cubic yards of the easternmost old magazine have been removed and wasted.

Concrete.—The first bucket of concrete was mixed and laid on April 28, and to June 30, 1897, 2,895 cubic yards of natural cement concrete have been laid. The entire Emplacement No. 3 is up to the ceiling heights of the various rooms and passages, while over the magazine, shell room, and contiguous part of the parapet the concrete is within 4 feet of the finish elevation. It is the intention to bring the entire surface to within 2 feet of the finish, when the whole will be brought up to completion as rapidly as possible, so as to secure a perfect bond for the finish courses. The walls about the relocating room and storerooms Nos. 2 and 3 are also to the ceiling elevation, and the parapet in front of them to the same height.

No Portland cement concrete has as yet been laid. Of Portland facing 68 cubic yards have been used in the walls of the various rooms, passages, and outer walls. The appearance of the walls is generally good.

Broken stone.—Fifty cubic yards of broken stone have been used in the floors of the rooms and their passages.

Mass stone.—Three hundred and eighty-six tons of millstone granite, in large masses, have been laid in the parapet and ceilings. None was used in the thinner walls, as it was found impossible to properly bed and ram the stones in the confined space.

I-beams.—Steel I-beams are used as a base upon which to build the ceilings of rooms and the works above them. As yet but two rooms have been covered, using 8,100 pounds of 12-inch beams.

Electric light, speaking tubes, drainage, etc.—Blocks of white pine 2 by 5 by 8 inches, bedded on edge in the concrete, the ends flush with the walls, and 1 foot below ceilings, are provided, upon which strips will be secured for convenience in running electric wires. One hundred and seventy of these have been placed.

Thirty-two feet of 1¼-inch galvanized-iron tubing is in place as ducts for carrying wires through walls and as speaking tubes, to be extended later to various points.

Drainage of gun pits, etc., is provided for by 4-inch cast pipe bedded in broken stone.

Material.—Delivery of material has been fair, only a few short delays having been noted from lack of material.

Men.—The number of men regularly employed is as follows: Superintendents, bosses, timekeepers, etc., 6; mechanics (hoisters, carpenters, blacksmiths, etc.), 17; laborers, 53.

Respectfully submitted.

L. S. JOHNSON,
United States Inspector.

Maj. D. W. LOCKWOOD,
Corps of Engineers, U. S. A.

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3 D.

DEFENSES OF EASTERN ENTRANCE TO LONG ISLAND SOUND.

Officer in charge, Maj. S. S. Leach, Corps of Engineers, with Lieut. W. J. Barden, Corps of Engineers, under his immediate orders since June 16, 1897; Division Engineer, Col. (now Brig. Gen.) John M. Wilson, Corps of Engineers, until February 11, 1897, and Col. G. L. Gillespie, Corps of Engineers, after that date.

Two emplacements for 12-inch rifles, disappearing carriages.—The instructions for the preparation of the general project required that in advance of and in line with that project, plans and estimates should be submitted for emplacements and platforms for two 12-inch B. L. rifles on United States disappearing carriages.

The Secretary of War on October 7, 1896, approved a site for these emplacements, and information of this fact reached me October 12, 1896. On October 19, plans and specifications were forwarded and were approved by the Chief of Engineers October 24, 1896. Advertisements were published October 28 and bids opened on the 28th of November.

A contract with J. W. Hoffman & Co., the lowest bidders, was approved; work to be completed November 1, 1897.

Under the contract actual operations were begun in March, 1897, and at the close of the fiscal year the dock was finished except the deck, the stone bins and two concrete mixers were in place, several

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derricks were erected, and the excavation for concrete completed. There is every reason to believe that the work will be completed on time.

The platforms are adapted to the model 1897 carriages.

An allotment of $115,000 for payment of contractor's estimates, and two aggregating $17,000 for engineering, superintendence, and contingencies of the emplacements have been made.

Money statements.

CONTRACT.

March 26, 1897, amount allotted		$115,000.00
June 30, 1897, amount expended during fiscal year		7,412.68
July 1, 1897, balance unexpended		107,587.32
July 1, 1897, outstanding liabilities	$10,858.74	
July 1, 1897, amount covered by uncompleted contracts	96,728.58	
		107,587.32

ENGINEERING, SUPERVISION, ETC.

August 18, 1896, amount allotted	60.000
December 10, 1896, amount allotted	16,400.00
	17,000.00
June 30, 1897, amount expended during fiscal year	8,948.57
July 1, 1897, balance unexpended	8,015.43
July 1, 1897, outstanding liabilities	626.93
July 1, 1897, balance available	7,388.50

Abstract of proposals for constructing gun emplacements opened by Capt. Smith S. Leach, Corps of Engineers, November 28, 1896.

No.	Name and address of bidder.	Emplacements.	Wharf.	Total.
1	Richard H. Broadhead, Marlboro, N. Y.	$119,588.00	$18,450.00	$138,038.00
2	John L. Grim, Girard Building, Philadelphia, Pa.	100,901.40	15,850.00	116,751.40
3	Manhattan Concrete Co., 156 Fifth avenue, New York City, N. Y.	121,099.90	22,250.00	143,349.90
4	Hartford Paving and Construction Co., Hartford, Conn.	103,384.80	19,975.00	123,359.80
5	S. & E. S. Belden, Hartford, Conn.	115,189.20	20,795.00	135,984.20
6	Edw. W. Everson, 17 Custom-House street, Providence, R. I.	117,222.50	22,100.00	139,322.50
7	Wilson & Baillie Manufacturing Co., 85–93 Ninth street, Brooklyn, N. Y.	111,481.20	15,090.00	126,571.20
8	Sooysmith & Co., 15 Broad street, New York, N. Y.	124,499.20	16,225.00	140,724.20
9*	J. W. Hoffman & Co., Harrison Building, Philadelphia, Pa.	91,098.80	15,530.00	106,628.80
10				
11	Isaac T. Brown, 39 and 41 Cortlandt street, New York	100,402.80	22,420.00	122,822.80
12	Richard M. Dudley, 18 Broadway, New York	97,729.40	17,400.00	115,129.40
13	William H. Baldwin, Yonkers, N. Y.	116,767.00	19,250.00	136,017.00
14	The Wardwell Bros. Co., Danbury, Conn	105,244.90	20,975.00	126,219.90
15	Hughes Bros. & Bangs, Syracuse, N. Y.	103,678.70	13,387.50	117,066.20

* Accepted.

List of contracts in force for gun and mortar batteries, defenses at eastern entrance of Long Island Sound.

Name of contractor.	Entered into.	Approved.	Work begun.	Contract expires.
J. W. Hoffman & Co., Philadelphia, Pa.	Dec. 11, 1896	Dec. 31, 1896	May 1, 1897	Nov. 1, 1897

Two emplacements for 10-inch rifles, disappearing carriages, and a mining casemate.—Plans for a mining casemate were submitted April 23, 1897, and approved May 1, 1897. Plans for emplacements and platforms for two 10-inch B. L. rifles on United States disappearing carriages, model 1896, together with specifications for the emplacements and the mining casemate, to be built under one contract, were forwarded May 12 and approved June 2, 1897.

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The work was advertised June 28, 1897.

An allotment of $11,000 for building the mining casemate and one of $10,000 for engineering, superintendence, and contingencies of the emplacements have been made.

Money statements.

TOPEDOES FOR HARBOR DEFENSE.

May 1, 1897, amount allotted	$11,000.00
July 1, 1897, balance unexpended	11,000.00

GUN AND MORTAR BATTERIES.

June 25, 1897, amount allotted from appropriation for "Gun and Mortar Batteries," act of March 3, 1897, for engineering, supervision, etc	10,000.00
July 1, 1897, balance unexpended	10,000.00
July 1, 1897, outstanding liabilities	27.75
July 1, 1897, balance available	9,972.25

3 E.

DEFENSES OF NEW YORK—AT EASTERN ENTRANCE TO HARBOR, ON ISLANDS IN HARBOR, AND ON STATEN ISLAND.

Officers in charge—at eastern entrance to harbor, Maj. J.G. D. Knight, Corps of Engineers, until July 21, 1896; after that date, Maj. H. M. Adams, Corps of Engineers; of remaining works, Maj. H. M. Adams, Corps of Engineers; assistant, Lieut. R. R. Raymond, Corps of Engineers, since July 18, 1896; Division Engineer, Col. (now Brig. Gen.) John M. Wilson, Corps of Engineers, until February 11, 1897, and Col. G. L. Gillespie, Corps of Engineers, after that date.

Mortar battery for sixteen 12-inch mortars.—During the past fiscal year the concrete slopes of the several pits and the concrete ramps have been completed; paving of floors of the magazines and passages with concrete has been completed; the sand embankment has been nearly finished, part of it has been covered with loam, sodded, and seeded; four iron ladders have been made and set in place; concrete placed, 518 cubic yards; concrete paving laid, 5,210 square feet; sand embankment 7,172 cubic yards; sod laid, 18,930 square feet; 350 square yards of the bank were covered with loam and seeded, and 26 cubic yards of macadam surface were placed upon the ramps.

A project for lighting the battery by electricity, the plant to be mounted in a building at the foot of the northwest pit, was approved by the Chief of Engineers February 8, 1897, and $5,200 was allotted for the work. The building has been completed and is ready for the plant.

The mortars and carriages were turned over, for use and occupation by troops, September 21, 1896.

Money statements.

MORTAR BATTERY.

July 1, 1896, balance unexpended	$17,738.56	$27,438.56
December 10, 1896, allotment	9,700.00	
June 30, 1897, amount expended during fiscal year		23,029.65
July 1, 1897, balance unexpended		4,408.91
July 1, 1897, outstanding liabilities		1,900.10
July 1, 1897, balance available		2,508.81

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ELECTRIC-LIGHTING PLANT.

February 8, 1897, allotment	5,200.00
June 30, 1897, amount expended during fiscal year	1,412.21
July 1, 1897, balance unexpended	3,787.79
July 1, 1897, outstanding liabilities	1,496.82
July 1, 1897, balance available	2,290.97

Two emplacements for 10-inch rifles, disappearing carriages.—The project is for construction of two emplacements for 10-inch B. L. rifles, mounted on Buffington-Crozier disappearing carriages, model 1896.

Work was begun in August, 1896. A wharf with two derricks was built for receiving materials and a track was laid and engine and cars purchased for transporting them to the battery; a cubical concrete mixer, worked by steam power, was set up. Excavation and embankment was mainly done by contract.

The platforms are ready for mounting gun carriages.

The parapet is about three-quarters completed; the concrete work of Emplacement No. 2 is nearly finished, and of Emplacement No. 1 about half finished. The total amount of concrete placed is 7,373 cubic yards.

To complete the battery there remains the placing of about 3,000 cubic yards of concrete in the parapet and over magazines, paving the magazine floors, grading and sodding the earth embankment, and purchasing and mounting the apparatus for handling ammunition and for lighting the magazines.

It is estimated that the available funds will be sufficient for this work, which will be completed this year.

The construction has been in local charge of Lieut. Robert R. Raymond, Corps of Engineers.

Money statement.

July 1, 1896, balance unexpended		$75,000.00
June 30, 1897, amount expended during fiscal year		45,739.62
July 1, 1897, balance unexpended		29,260.38
July 1, 1897, outstanding liabilities	$4,914.38	
July 1, 1897, amount covered by uncompleted contracts	640.74	
		5,555.12
July 1, 1897, balance available		23,705.26

One emplacement for 12-inch rifle, disappearing carriage.—The construction of a single emplacement for a 12-inch B. L. rifle, mounted on Buffington-Crozier disappearing carriage, model 1896, was authorized by indorsement of the Chief of Engineers, dated April 23, 1897. Supplies have been purchased and a railroad from the wharf to the battery site has been nearly completed. Construction work is about to be begun.

Money statement.

April 23, 1897, allotment	$50,000.00
June 30, 1897, amount expended during fiscal year	2,137.20
July 1, 1897, balance unexpended	47,862.80
July 1, 1897, outstanding liabilities	2,087.39
July 1, 1897, balance available	45,775.41

Sea wall at Fort Schuyler, N. Y.—Under an allotment from the appropriation for sea walls and embankments, the wall has been repaired in places which showed weakness. Loose stones have been taken up and reset, missing stones have been replaced, and parts of the wall have been practically rebuilt. The base of the wall in exposed places has been riprapped with native stone.

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Money statement.

July 1, 1896, amount allotted	$4,225.00
June 30, 1897, amount expended during fiscal year	3,341.00
July 1, 1897, balance unexpended	884.00
July 1, 1897, outstanding liabilities	261.20
July 1, 1897, balance available	622.80

Two emplacements for 10-inch and two for 8-inch rifles, disappearing carriages.—The construction of Emplacements Nos. 1, 2, and 3 for the gun battery was authorized May 15, 1891; of Emplacement No. 6, April 22, 1897.

During the past year, at the first three emplacements, the platform steps and retaining walls at magazine entrances have been built; concrete floors in the recesses have been laid; magazine and platform doors have been made and hung; hand rails for platforms and stairs have been placed; trolleys, hoists, and cranes for handling ammunition have been put up; manholes and covers have been built in the platforms. The platform of the first emplacement settled slightly, owing to the character of the ground beneath. It was loaded with 55 tons of granite and iron, and the settling has about ceased. To complete these three emplacements, there remains the leveling off of the platform of Emplacement No. 1 and the building of a road to the battery.

Work upon Emplacement No. 6 was begun in May, 1897; three 15-inch Rodman guns were dismounted from the site; the excavation for the emplacement has been made; machinery for mixing concrete has been set up and 70 cubic yards of concrete has been laid in the foundation for the platform and magazine.

Money statement.

July 1, 1896, balance unexpended	$13,586.58	
April 22, 1897, amount allotted	45,000.00	
		58,586.58
June 30, 1897, amount expended during fiscal year		12,955.45
July 1, 1897, balance unexpended		45,631.13
July 1, 1897, outstanding liabilities		3,947.14
July 1, 1897, balance available		41,683.99

Mortar battery.—This work was authorized April 23, 1897. Detailed plans for construction of eight platforms have been prepared, and the cut stone for these platforms has been ordered, at a cost of $5,049.60. Excavation for drains has been begun.

Money statement.

April 23 and May 17, 1897, amount allotted	$14,000.00
July 1, 1897, balance unexpended	14,000.00
July 1, 1897, outstanding liabilities	174.00
July 1, 1897, balance available	13,826.00

Preservation and repair of fortifications.—By Department letter of June 14, 1897, $2,000 was allotted for repairs to the engineer wharf, sea wall, and storehouse, and for cleaning the sewer under the stone fort. Work of repairing the sea wall has been begun, and about 50 cubic yards of riprap has been placed in the wall east of the long wharf.

Money statement.

June 14, 1897, amount allotted	$2,000.00
July 1, 1897, balance unexpended	2,000.00
July 1, 1897, outstanding liabilities	22.40
July 1, 1897, balance available	1,977.60

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Defenses on Staten Island—Five emplacements for 8-inch rifles, disappearing carriages.—During the past fiscal year hand rails have been placed around the loading platform and cranes have been mounted for lifting ammunition up to the platforms; trolleys and hoists have been purchased and set up in the several magazines for transporting ammunition.

The battery is now complete.

Money statement.

July 1, 1896, balance unexpended	$11,281.27	
December 3, 1896, withdrawn	7,000.00	
		$4,281.27
June 30, 1897, amount expended during fiscal year		2,432.04
July 1, 1897, balance unexpended		1,849.23
July 1, 1897, outstanding liabilities		135.64
July 1, 1897, balance available		1,713.59

Four emplacements for 10-inch rifles, disappearing carriages.—This is a project for the construction of two batteries, each with two positions for 10-inch B. L. rifles, mounted on Buffington-Crozier disappearing carriages, model 1896.

Work on these batteries was begun in July, 1896, and in December, 1896, the platforms were ready for mounting gun carriages.

The parapets, platforms, and magazines of both batteries are completed; roadways have been built in the rear of the batteries, and drains have been laid.

In constructing one of the batteries 11,528 cubic yards of earth was excavated and placed in embankment. The battery contains 8,946 cubic yards of concrete, exclusive of paving.

The other battery required excavation and embankment of 10,586 cubic yards of earth, and the battery contains 9,150 cubic yards of concrete, exclusive of paving.

In connection with this work the dock was repaired by driving 6 bents of piles of 4 piles each, to strengthen it for receiving and handling 10-inch guns and carriages.

A carriage is being mounted in the first position of one battery.

To complete these batteries there yet remains the placing of lifts, trolleys, hoists, and cranes for handling ammunition, the wires for electric lighting in the magazines, and a small amount of grading and sodding.

Artillery fire control.—The project consists in building range-finder, observation, and search-light stations for directing and controlling the fire of the new batteries, in installing an electric plant for communication between the several stations, the plant also to be used for lighting the magazines in the batteries. Two casemates were set apart for the electric plant.

Concrete floors have been built in the casemates and the necessary electric plant has been installed.

Money statement.

July 1, 1896, balance unexpended	$200,000.00	
November 25, 1896, withdrawn	25,000.00	
		$175,000.00
June 30, 1897, amount expended during fiscal year		109,066.76
July 1, 1897, balance unexpended		65,933.24
July 1, 1897, outstanding liabilities		5,131.68
July 1, 1897, balance available		60,801.56

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3 F.

DEFENSES OF SOUTHERN ENTRANCE TO NEW YORK HARBOR, ON LONG ISLAND AND SANDY HOOK.

Officers in charge, Col. G. L. Gillespie, Corps of Engineers, to February 23, 1897, and Lieut. Col. William Ludlow, Corps of Engineers, since that date; assistant, Lieut. Robert McGregor, Corps of Engineers.

Defenses on Long Island; 10-inch gun battery.—By direction of the Chief of Engineers, July 23, 1892, detailed drawings with estimate of cost were submitted October 18, 1892, for the construction of Emplacement No. 7 of the proposed battery for seven 10-inch disappearing guns.

The estimated cost of the entire battery, consisting of seven emplacements, eight magazines, and eight casemates for rapid-fire guns is $413,290.40, of which $393,936 is for masonry construction and $19,354.40 for earth excavation and embankment. The original estimated cost of the eastern emplacement (No. 7), with two magazines and two casemates for rapid-fire guns, was $103,266.80, of which $98,936 was applicable to masonry and $4,330.80 to excavation and embankment.

The project submitted October 18, 1892, was approved by the Chief of Engineers, and the sum of $82,000 was allotted for the work from the appropriation for gun and mortar batteries, act July 23, 1892. Under instructions from the Secretary of War, dated October 18, 1892, the work of excavation was begun October 24, 1892. The project was completed September 30, 1894, without further allotment. It included Emplacement No. 7 complete except platform, the magazine for Emplacement No. 6, and two casemates for rapid-fire guns, made by remodeling existing traverse magazines.

On June 5, 1895, an estimate was submitted to the Chief of Engineers for the construction of the platform in Emplacement No. 7, adapted to the United States disappearing carriage, model 1894, and an allotment of $3,638.25 was made for its construction. Work was begun September 1 and suspended November 27, 1895, at which date the platform was completed with the exception of setting the base rings, which were not received until December.

One 10-inch B. L. rifle for this battery was received November 13 and placed on the parapet ready for mounting when the carriage should be received.

On February 24, 1896, a project was submitted and received the approval of the Chief of Engineers, involving a modification of the original plans of this battery. The earthen traverses were to be removed from the magazines, and a rearrangement of the magazines (afterwards further modified) was effected.

OPERATIONS DURING THE FISCAL YEAR.

On June 29, 1896, an allotment of $70,000 was made from the appropriation for gun and mortar batteries, act June 6, 1896, for the completion of Emplacement No. 6, and the construction of Emplacement No. 5 of the 10-inch gun battery, with platform adapted to the United States disappearing carriage, model 1894, and in connection therewith the modification of two traverse magazines to fit them for 6-pounder rapid-fire guns.

The work of excavation began July 7, 1896.

Pending the execution of formal contracts, one month's supply of

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material was purchased in open market and the work of placing concrete was begun on July 29.

Detailed plans for this work were prepared and received the approval of the Chief of Engineers July 22, 1896.

Emplacements Nos. 6 and 7 are built according to the earlier plans of The Board of Engineers. The magazines of Emplacement No. 5 are arranged according to the later plans, having the ammunition delivery by lifts, in the rear.

In connection with this work was undertaken the removal of the earth traverses from Magazines Nos. 6 and 7, as approved by the Chief of Engineers February 24, 1896.

In order to keep the crest line of the battery at the same level throughout as that of the earlier construction, the cut of the present work considerably exceeds the fill. The surplus material is spread to grade on the low land to the eastward of the battery.

In the concrete construction, all exposed corners, exterior and interior, including door jambs, are built of granite quoins cut from the platforms and other stone of the old work.

The ammunition service is in accordance with the plans of The Board of Engineers. The overhead tramrails are 5-inch I-beams, secured to the sealing beams by through bolts. For each line of tramrail there is one wrought-iron four-wheel trolley, with self-oiling bearings, carrying one Weston triplex block of 1,000 pounds capacity. The cranes are of the later pattern, supplied with the same form of hoist.

Platform No. 5 is to be provided with lifts for delivering the ammunition from the magazine floor to the loading platform.

Emplacements Nos. 6 and 7, being of the old type, are arranged for hand delivery, the shot being raised by cranes near the magazine opening.

On February 9, 1897, a project was submitted and received the approval of the Chief of Engineers for electrically lighting the emplacement under construction and the two already built. It consists of an oil engine, a dynamo with necessary switchboard and fittings, and thirty-six incandescent lamps. The wiring is carried in iron conduits throughout, with waterproof outlet boxes for lamps and switches. The light in the magazines and shell rooms are 32 candlepower, fitted with waterproof globes and metal guards. The wires in these rooms are run in brass tubing. All other lights are 16 candlepower, without globes or guards.

The dynamo and switchboard are arranged to be operated in connection with a storage battery of small capacity, to furnish occasional light when the engine is not running, and to carry the load for a short time in an emergency, should the dynamo or engine fail. The battery has not yet been installed, but will be at an early date.

On May 29, 1897, an allotment of $45,000 was made from the appropriation for gun and mortar battery, act of March 3, 1897, for the construction of Emplacement No. 4 of the battery adapted to the United States disappearing carriage, model 1896. The other platforms in the battery are for model 1894.

At the close of the fiscal year, June 30, 1897, the condition of this work was as follows:

Emplacements Nos. 6 and 7 are completed ready for service in every respect.

Emplacement No. 5 is completed ready for service, excepting the ammunition lifts.

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In connection with these emplacements four magazine traverses have been remodeled into casemates for 6-pounder rapid-fire guns.

The excavation for Emplacement No. 4 is in progress, the amount excavated being 3,365 cubic yards.

Table of expenditures for the fiscal year ending June 30, 1897, on 10-inch disappearing gun battery.

Repairs and maintenance of plant		$1,967.63
Excavation, 22,285 cubic yards, at 49 cents		10,919.65
Rosendale concrete, 6,798 cubic yards, at $4.25		28,891.50
Portland concrete, 341 cubic yards, at $5.33		1,817.53
Granite quoins, 707 linear feet, at $6.77		4,786.39
Granite stone taken out of old masonry, 1,500 cubic feet		302.70
Granolithic pavements, 630 square yards, at $2.01		1,266.30
Cement pavements, 765 square yards, at $1.22		933.30
Finishing exterior and interior walls and ceilings, including whitewashing and also the breaking down and scraping of concrete affected by frost, 22,500 square feet, at 9¼ cents		2,137.50
Drain pipe, 355 feet, at 55 cents		195.25
Remodeling 2 rapid-fire casemates		149.32
Finishing slopes and sodding, 700 square yards, at 63 cents		441.00
Macadam pavement in ditch, 385 square yards, at $1		385.00
Ceiling beams, 21,811 pounds, at 2.33 cents		508.20
Ironwork, including ladders, railing, and drain covers, 1,600 pounds, at 11 cents		176.00
Conduits for speaking tubes and hoist ropes, 266 feet, at 20 cents		53.20
Platform bolts, including setting of base plates and traverse circles on two platforms, 8,465 pounds, at 4.4 cents		372.46
Tramrail, with trolleys and hoists, 556.33 feet, at $2.01		1,118.22
8 Ammunition cranes, with blocks and tongs		691.50
Doors for 21 openings:		
4,000 feet of lumber, at $54 per M	$216.00	
Paint and oil	19.05	
1,011¼ pounds bronze fittings, at 25 cents	252.88	
Locks and screws	115.68	
Labor, making and hanging	714.30	
		1,317.91
Electric-light plant:		
1 7-horsepower oil engine	$830.00	
1 4-K. W. dynamo	285.00	
1 switchboard and fittings	166.75	
	1,281.75	
Cost of erecting	114.27	
Material and wiring for 36 lamps	574.75	
		1,970.77
Demolition of masonry, blasting		10.26
Emplacement No. 7, cutting manhole for access to counterpoise weights of gun carriage		91.30
Breaking down concrete over traverses		207.38
Superintendence and office expenses		3,391.30
Total		64,101.57

Money statement.

GUN AND MORTAR BATTERIES.

July 1, 1896, balance unexpended	$70,726.94
May 29, 1897, allotment	45,000.00
	115,726.94
June 30, 1897, amount expended during fiscal year	58,594.52
July 1, 1897, balance unexpended	57,132.42
July 1, 1897, outstanding liabilities	5,347.18
July 1, 1897, balance available	51,785.24

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Abstracts of proposals for delivery of sand, stone, and cement for concrete received in response to advertisement dated July 21, 1896, and opened August 21, 1896, by Col. G. L. Gillespie, Corps of Engineers.

No.	Name of bidder.	Delivered on Long Island.							
		Building sand, 2,500 cubic yards.		Small broken stone, 5,000 cubic yards.					
				Granite.		Trap rock.		Limestone.	
		Per cubic yard.	Amount.	Per cubic yard.	Amount.	Per cubic yard.	Amount.	Per cubic yard.	Amount.
1	H. Goodwin	$0.54	$1,350.00						
2	Phœnix Towing and Transportation Co	.42 9/10	1,072.50						
3	The Newark and Rosendale Lime and Cement Co								
4	J. Frank Quinn					$1.50	$7,500.00		
5	New York and Rosendale Cement Co								
6	Jacob E. Conklin					1.19	5,950.00		
7	Daniel J. Donovan	.88	2,200.00	$1.34	$6,700.00				
8	Walter C. Butler							$1.24	$6,200.00
9	Andrew A. Bouker	.90	2,250.00						
10	Francis H. Smith	.75	1,875.00	*1.07	5,350.00				
11	Lawrenceville Cement Co								

No.	Name of bidder.	Delivered on Long Island.						Total amounts.
		Large broken stone, 800 tons.		Fine-crushed granite, 100 cubic yards.		American Rosendale cement, 10,000 barrels.		
		Per ton.	Amount.	Per cubic yard.	Amount.	Per barrel.	Amount.	
1	H. Goodwin							$1,350.00
2	Phœnix Towing and Transportation Co							1,072.50
3	The Newark and Rosendale Lime and Cement Co					$0.76	$7,600.00	7,600.00
4	J. Frank Quinn	$0.65	$520.00					8,020.00
5	New York and Rosendale Cement Co					.74 9/10	7,490.00	7,490.00
6	Jacob E. Conklin							5,950.00
7	Daniel J. Donovan			$2.80	$280.00			9,180.00
8	Walter C. Butler			†1.24	124.00	.74 8/10	7,480.00	13,804.00
9	Andrew A. Bouker	.68	544.00					2,794.00
10	Francis H. Smith			‡2.50	250.00			7,475.00
11	Lawrenceville Cement Co					.76	7,600.00	7,600.00

No.	Name of bidder.	Delivered at Sandy Hook.							
		Small broken stones, 7,500 cubic yards.						Large broken stone, 1,000 tons.	
		Granite.		Trap rock.		Limestone.			
		Per cubic yard.	Amount.	Per cubic yard.	Amount.	Per cubic yard.	Amount.	Per ton.	Amount.
1	H. Goodwin								
2	Phœnix Towing and Transportation Co								
3	The Newark and Rosendale Lime and Cement Co								
4	J. Frank Quinn			$1.50	$11,250.00			$0.65	$650.00
5	New York and Rosendale Cement Co								
6	Jacob E. Conklin			1.29	9,675.00				
7	Daniel J. Donovan	$1.45	$10,875.00						
8	Walter C. Butler					$1.34	$10,050.00		
9	Andrew A. Bouker							.73	730.00
10	Francis H. Smith								
11	Lawrenceville Cement Co								

* Bid for sea-washed silica gravel.
† Bid for fine crushed limestone; not suitable.
‡ Bid for fine sea-washed silica.

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Abstracts of proposals for delivery of sand, stone, and cement for concrete received in response to advertisement dated July 21, 1896, etc.—Continued.

No.	Name of bidder.	Delivered at Sandy Hook.					Remarks.
		Fine-crushed granite, 100 cubic yards.		American Rosendale cement, 12,000 barrels.		Total amount.	
		Per cubic yard.	Amount.	Per barrel.	Amount.		
1	H. Goodwin	.....	.....	.....	.....	.....	Bid informal.
2	Phœnix Towing and Transportation Co	.....	.....	.....	.....	.....	Lowest bid for sand.
3	The Newark and Rosendale Lime and Cement Co	.....	.....	$0.78	$9,360.00	$9,360.00	
4	J. Frank Quinn	.....	.....	.....	.....	11,900.00	Lowest bid for large broken stone.
5	New York and Rosendale Cement Co	.....	.....	.79 2/10	9,588.00	9,588.00	
6	Jacob E. Conklin	.....	.....	.....	.....	9,675.00	Lowest bid for small broken stone, Sandy Hook.
7	Daniel J. Donovan	$3.00	$300.00	.....	.....	11,175.00	Lowest bid for fine-crushed granite, Sandy Hook.
8	Walter C. Butler	*1.34	134.00	.74 8/10	8,976.00	19,160.00	Lowest bid for Rosendale cement.
9	Andrew A. Bouker	.....	.....	.....	.....	730.00	
10	Francis H. Smith	.....	.....	.....	.....	.....	Lowest bid for small broken stone and fine-crushed granite, or their equals, Long Island.
11	Lawrenceville Cement Co.	.....	.....	.76½	9,180.00	9,180.00	

* Bid for fine-crushed limestone; not suitable.

Contracts in force.

With Walter C. Butler, dated September 1, 1896, approved by the Chief of Engineers September 10, 1896, for furnishing 10,000 barrels "Old Newark" Rosendale cement at 74.8 cents per barrel; deliveries began September 7, 1896, and were completed December 1, 1896.

With Francis H. Smith, dated September 2, 1896, approved by the Chief of Engineers September 24, 1896, for furnishing 5,000 cubic yards of sea-washed silica gravel, at $1.07 per cubic yard, and 100 cubic yards of sea-washed silica at $2.50 per cubic yard; deliveries began September 8, 1896, and were completed December 1, 1896.

Ten-inch gun battery No. 1.—Under date of June 29, 1896, the Chief of Engineers authorized a battery of two 10-inch guns on disappearing carriages on the site approved for the second gun-lift battery, and a battery of three 10-inch guns on disappearing carriages for one of the iron casemates. These changes were made in the interest of economy and under the necessity for immediate construction.

At the close of last fiscal year one mortar battery with ditch defenses had been constructed, having its armament of sixteen 12-inch mortars complete, and also one gun-lift battery, armed with two 12-inch high-power guns mounted on hydraulic lifts.

Defenses at Sandy Hook—Mortar battery No. 1.—This mortar battery, built on the typical plan, was begun in November 1890, under instruction from the Chief of Engineers, dated August 6 and September 13, 1890, in accordance with plans of The Board of Engineers dated September 28, 1888.

The battery was completed in October, 1894, with the exception of the lighting and the power for handling shot. The light installation was completed in April, 1895, and the overhead tramrail and hoists were put in place in November, 1895. The total cost of the battery including all accessories was $270,724.67.

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Gun-lift battery No. 1.—This battery is arranged for two 12-inch B. L. rifles, model 1888.

Excavations for the foundations of the northern half of the battery were commenced in January, 1891, under instructions from the Chief of Engineers dated February 20, 1890, and September 13, 1890; and on April 3, 1891, further instructions were received for the construction of the southern half of the battery.

The original estimated cost of the masonry and sand covering for a battery of this type was $283,000 (Report of The Board of Engineers, September 3, 1890).

The original estimated cost of a single gun lift, including hydraulic ram and all fittings, was $61,980, and that of the hydraulic power for not exceeding two lifts was $50,570, making the total estimated cost of the mechanism of the two lifts $174,530 (inclosure to the letter from the Chief of Engineers, February 20, 1890).

The total estimated cost of a battery of this type for two guns was therefore $457,530. The actual cost of construction was $455,028.23, of which $282,668.23 was for masonry and sand covering and $172,360 for mechanism. It is provided with a masonry defensible entrance in two stories.

The construction of the battery was completed and the mechanism tested in March, 1894; but owing to the nonreceipt of the second gun carriage the armament of the battery was not completed until June, 1895.

Experiments conducted at different times, to ascertain the time consumed in the various operations of the mechanism, have confirmed the following results:

The time consumed in ascent or decent of the gun is from 15 to 20 seconds.

The time of ascent of the ammunition lifts is 7 seconds.

The time required for the power to furnish head for a single lift is 1 minute 40 seconds.

The two lifts moving alternately can be worked at the rate of 2 minutes between lifts.

On August 7, 1895, a test of rapidity of fire of this battery was made under the direction of the Board of Ordnance and Fortification. Five shots were fired from each lift, under the direction of the Ordnance Department. The shots were to be fired alternately from the two guns. All the time consumed in traversing the guns and in delays not incidental to the carriages or mechanism was noted for final deduction.

A record was kept of the time of ascent and descent in each case, and also of the steam pressure and quantity of water in boilers throughout. The mechanism worked well throughout, and the power proved ample for all demands that could be made upon it.

The south half of the battery, being of later and more efficient construction, proved, as was expected, much the more effective of the two. This gun, which fired the second shot of the series, fired its fifth shot before the fourth shot from the north lift, besides being subject to delays while waiting for the north gun to fire.

The average corrected interval between shots, both lifts being considered, was 3 minutes 23.7 seconds, corresponding to an interval of 6 minutes 47.4 seconds between shots from a single gun.

The actual corrected time of firing five shots from the south lift was 17 minutes 10 seconds, corresponding to an interval of 3 minutes 26 seconds between shots from a single gun.

The quickest time for the full cycle—loading, ascent, firing, and

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descent—was 2 minutes 12 seconds, made on the second round from the south lift. As the south lift is the later pattern, it may be said to represent the adopted construction.

OPERATIONS DURING THE FISCAL YEAR.

Ten-inch battery No. 1.—On June 29, 1896, an allotment of $100,000 was made from the appropriation for gun and mortar batteries, act June 6, 1896, for the construction of one battery of two 10-inch guns on United States disappearing carriages, model 1896. At the same time instructions were received to proceed with least possible delay, to the end that as much work as possible be done before the close of the working season.

The preparation of plans was begun at once, and at the same time was begun the work of overhauling the plant, which had been stored since 1894, and getting it to the site.

The plans were approved by the Chief of Engineers July 24, 1896. They conformed to the typical drawings of The Board of Engineers for this caliber of gun.

The magazine floors were placed at 8 feet above mean low-water level; a series of water-level observations extending over one month having shown that this would place the lowest point of the foundations (El. 6.0) above the level of water in the soil.

The site was cleared and the installation of the plant completed sufficiently by August 6 to begin receiving materials. The excavation for the battery, which was small in amount, was begun July 28, and carried on coincidently with erection of the plant.

The laying of concrete was begun August 25. Work was carried on by hand at first, owing to the breaking, during the first day's run, of a new gear wheel that had been furnished for the mixer. Mixing by machinery was begun on September 2.

On September 9 a complete extra force for mixing and placing concrete was put on the work and the mixer run sixteen hours per day, except Saturdays and Mondays, when the run was twelve hours.

The mixing machine was of the Duane type, with hollow shaft for supplying water, the materials being put in from a charge car without previous mixing. The machine was run at the rate of 14 revolutions per minute, each charge being given 16 turns or more, depending on the dryness of materials. With this treatment the concrete was always found to be thoroughly mixed.

The body of the masonry is built of Rosendale concrete in the proportion of 1 cement, 2 sand, and 5 broken stone. The platforms are built of American Portland concrete in the proportions of 1 cement, 3 sand, and 7 broken stone. All exposed corners of masonry, inside and outside, including door jambs, are built up with quoins of brick carried up simultaneously with the concrete, thus insuring a perfect bond.

The facing for the walls, the interior pavement and the top pavement for the magazine traverses is of Rosendale mortar in the proportion of 1 part cement to 1½ parts sand. All the exterior pavement is granolithic—1 cement, 2 sand, and 5 crushed granite.

The walls surrounding the rooms and passages are built with hollows extending 2 feet above the ceilings. At this level, and extending to the hollows in the walls is placed a waterproof covering of asphalt mixed with 10 per cent of coal tar and 25 per cent of sand.

At the close of the month of November, five months after the preparation of the project was begun, the masonry of the battery and

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platforms was completed and the paving was in progress. The platform bolts were set and the platforms themselves ready for the guns November 15.

A heavy fall of snow on the night of November 29, attended by continued cold weather, caused the cessation of paving work until spring. The concrete plant was laid up and arrangements begun for filling the sand in the main parapet, which had to be brought from a bank about 700 feet in rear. The cut over the sight of the battery was small, ranging from 4 feet at the deepest point to about 1 foot, thus requiring a large amount of sand to be excavated elsewhere. The filling was completed March 17, and the plant removed. The weather admitted of beginning the laying of pavement on March 1. The top surfaces and faces where injured by frost had been cleared off and new forms erected for pavements. The pavement was completed May 15.

The overhead tram rails and hoists for moving ammunition were purchased on April 15, and the installation was completed May 26. It consists of eight lines of 5-inch I-beams (four in each emplacement) secured to the ceiling beams by malleable clips, with one four-wheel trolley and hoist to each line. The hoists are of the Weston triplex pattern, and the whole installation has been tested to 1,000 pounds in place.

The cranes, two for each platform, were erected May 17. A test of their capacity on June 4 showed that one man can raise a 10-inch armor-piercing shot the full height of the lift—18 feet—in 1¼ minutes and two men can raise the same load in 50 seconds.

The electric light wiring is completed, except the switch board. The storage battery, which is to furnish light for the battery in connection with the gun-lift dynamo has not been purchased, but the battery can be lighted direct from the dynamo when occasion requires. There are 19 lights in the entire battery, 8 of which—those in the magazine and shell rooms—are 32 candlepower; the remainder are 16 candlepower. The wiring is done in iron-armored conduits, with waterproof outlets.

On May 18, notification was received that the two carriages for this battery were at the proving grounds and that one of them would be turned over for mounting at once. Under instructions from the Chief of Engineers, dated May 22, this work is being done by the Engineer Department.

At the close of the fiscal year this battery was complete in all its details except the ammunition lifts. These will be put in at an early date.

The following table gives the cost of construction in detail:

Repairing and installing plant		$7,135.59
Construction of permanent railroad track, 3-foot gauge		1,246.60
Clearing site for battery		140.50
Excavation for foundation		361.25
Rosendale concrete in parapet:		
228 cubic yards by hand, at $4.40	$1,003.20	
9,344 cubic yards by machine, at $4.15	38,765.77	
317 cubic yards Portland concrete, at $4.721	1,496.56	
422 cubic yards rubblestone, at $3.59	1,514.98	
1,487 cubic yards Rosendale paving, at $0.974	1,447.81	
1,112 cubic yards of granolithic paving, at $2.304	2,561.97	
		46,790.29
Drain pipe		41.34
37,000 brick, in place, at $26.88		994.66
Waterproofing, 412 square yards, material and labor, at 33 cents		137.15
Whitewashing, 795 square yards, at 15.2 cents		120.94
Stonecutter		28.50

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Ironwork:		
4,100 pounds platform bolts and washers, in place, at 3.6 cents	$147.12	
27,970 pounds of steel beams, in place, at 2.5 cents	698.03	
200 feet speaking tube, iron	20.50	
		$865.65
Electric wiring, 20 lamps, at $8.69		173.81
Trolley lines, 317 feet, at $2.466		781.90
Cranes		333.84
Hand rails		117.76
Doors:		
2,621 feet of lumber	193.11	
787 pounds bronze fittings	149.53	
19 locks	105.00	
Paint	34.78	
Labor, making and hanging	480.82	
Twenty openings, at $48.16	963.24	963.24
Installing plant for sand filling	719.84	
Cost of sand filling, 12,506 cubic yards, at 25.4 cents	2,460.30	
		3,180.14
Grading and clearing up site		994.27
Assembling and mounting 10-inch B. L. rifle and carriage		1,000.00
Legal holidays, including time lost by rain, etc		115.88
General labor		174.54
Repair and maintenance of plant and buildings, including care of public animals		5,963.53
Material on hand, lumber and fittings for doors		195.99
Superintendence and office expenses		2,731.55
Total expenditures to June 30, 1897		74,588.92

Ten-inch battery No. 2.—This battery is designed for three guns on disappearing carriages, model 1896.

The project was approved June 29, 1896, and instructions received to invite bids for its construction under contract.

Bids were opened November 28, and in accordance therewith a contract was entered into with Frank W. Molloy, of New Rochelle, N. Y., for its construction.

The estimated quantities of the various classes of materials, with the contract prices, are given below:

2,000 cubic yards earth excavation, at 12 cents.
1,800 cubic yards stone demolition, at 50 cents.
27,000 cubic yards sand filling, at 15 cents.
11,500 cubic yards concrete, Rosendale, at $4.45.
1,500 cubic yards concrete, Portland, at $5.
750 cubic yards random stone, at $1.50.
1,100 square yards pavement, Rosendale, at $1.
1,000 square yards pavement, granolithic, at $2.
850 square yards asphalt, waterproofing, at 50 cents.
45,000 brick, at $20.
45,000 pounds steel beams, at 3 cents.
6,450 pounds anchor nuts, bolts, and washers, at 5 cents.
400 linear feet cast-iron pipe, 4-inch, at 35 cents.
150 linear feet vitrified pipe, 4-inch, at 25 cents.
150 linear feet vitrified pipe, 6-inch, at 30 cents.
300 linear feet iron pipe railing, at 50 cents.
150 pounds iron drain covers, at 15 cents.
15 each, single doors, with fittings, at $10.
13 each, double doors, with fittings, at $15.
450 linear feet trolley line, at $3.50.
6 each, hoists and fixtures, at $500.
6 each, steel cranes, at $300.

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The contract requires that the work shall be commenced on or before April 1, and completed on or before November 1, 1897. The contractor is given the free and full use of the engineer wharf, plant, and buildings, should he require them, with the proviso that they shall be kept in good condition.

Work was commenced on March 31. The progress of the work has been slow and unsatisfactory from the first, partly owing to the cheap labor which the contractor has employed and partly to the lack of proper conception of the work by the contractor himself. Materials wanted first have been slow to arrive, and considerable have been rejected as not filling the requirements of the specifications.

The excavation was not sufficiently advanced to begin mixing concrete until May 20, when work of mixing and placing by hand was begun. The average quantity placed per hour is 3.1 cubic yards.

The quantities of work under the contract at the close of the fiscal year were:

2,956 cubic yards earth excavation.
1,142 cubic yards stone demolition.
1,203 cubic yards concrete, Rosendale.
339 cubic yards random stone.
8,000 brick.
80 linear feet vitrified drainpipe, 4-inch.

Disappearing gun battery for 12-inch guns.—On June 3 a project was submitted, which received the approval of the Chief of Engineers, for the construction of emplacements for two 12-inch B. L. rifles on United States disappearing carriages, model 1896.

This battery is to be constructed by hired labor. Some necessary track material has been purchased, the arrangement of the plant laid out, and operations will be begun as soon as the work under the Molloy contract will admit of using the wharf and plant.

On June 29, 1896, an allotment of $4,000 was made for the construction of one emplacement for one 5-inch rapid-fire gun, but no work has yet been done.

The work during the present season has been slow, owing to lack of accommodations for employees. Under the system adopted by the contractor the engineer boarding house is not run as such, but is operated as a store, the men doing their own cooking in their quarters. The engineer laborers are boarded with the ordnance men, where the accommodations are very limited.

Preservation and repair.—The roof of the torpedo shed has been repaired and the ironwork painted at a cost of $240.97.

The allotment of $5,000 made June 25, 1895, for maintenance of the gun lift battery and for certain experiments was exhausted October 27, 1896. On September 23 an allotment of $700 was made from the appropriation for preservation and repair of fortifications, act of June 6, 1896. With this allotment, and with a small balance remaining from construction, the battery was maintained until June 3, when an additional allotment of $90 was made from the appropriation for preservation and repair, act of March 3, 1897, for the remainder of the year.

On December 26, 1896, a detail of two privates of artillery reported for duty to learn the care and operation of this battery. They have continued on duty, and have justified dispensing with all but one civilian attendant.

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Besides being used itself annually for target practice, this battery furnishes light for two other batteries—the mortar battery and the 10-inch battery lately constructed.

First Lieut. Robert McGregor, Corps of Engineers, has had local supervision of all works appertaining to fortifications under my charge, and has uniformly discharged his duties with marked intelligence, zeal, and discretion.

Money statements.

GUN AND MORTAR BATTERIES.

July 1, 1896, balance unexpended		$104,753.10
October 24, 1896, allotment from appropriation, act June 6, 1896	$250.00	
December 9, 1896, allotment from appropriation, act March 2, 1895	3,440.00	
June 9, 1897, allotment from appropriation:		
Act March 2, 1895 $34.77		
Act March 3, 1897 96,965.23		
	97,000.00	
August 6, 1896, amount received from transfer of horses	300.00	
		100,990.00
		205,743.10
June 30, 1897, amount expended during fiscal year		71,779.50
July 1, 1897, balance unexpended		133,963.60
July 1, 1897, outstanding liabilities		4,231.24
July 1, 1897, balance available		129,732.36

GUN AND MORTAR BATTERIES.

Contract Work.

March 27, 1897, allotment from appropriation, act March 3, 1897		$90,000.00
June 30, 1897, expended during fiscal year		1,848.46
July 1, 1897, balance unexpended		88,151.54
July 1, 1897, outstanding liabilities	$5,119.11	
July 1, 1897, covered by contract	71,234.93	
		76,354.04
July 1, 1897, balance available		11,797.50

PRESERVATION AND REPAIR OF FORTIFICATIONS.

September 3, 1896, allotment from appropriation, act June 6, 1896	$400.00	
September 23, 1896, allotment from appropriation, act June 6, 1896	700.00	
June 3, 1897, allotment from appropriation, act March 3, 1897	90.00	
June 14, 1897, allotment from appropriation, act March 3, 1897	3,380.00	
		$4,570.00
June 30, 1897, amount expended during fiscal year		859.03
July 1, 1897, balance unexpended		3,710.97
July 1, 1897, outstanding liabilities		330.97
July 1, 1897, balance available		3,380.00

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Abstract of proposals for the erection of a battery received in response to advertisement dated October 20, 1896, and opened November 23, 1896, by Col. G. L. Gillespie, Corps of Engineers.

No.	Name of bidder.	11,500 cubic yards concrete masonry, Rosendale cement.		1,500 cubic yards concrete masonry, American Portland cement.		750 cubic yards large broken stone.		1,100 square yards pavement, Rosendale cement mortar.	
		Per cubic yard.	Amount.	Per cubic yard.	Amount.	Per cubic yard.	Amount.	Per square yard.	Amount.
1	Irving A. Hodge	$4.87	$56,005.00	$6.00	$9,000.00	$0.80	$600.00	$0.75	$825.00
2	John L. Grim	5.20	59,800.00	7.50	11,250.00	2.60	1,950.00	1.50	1,650.00
3	Frank W. Molloy	4.45	51,175.00	5.00	7,500.00	1.50	1,125.00	1.00	1,100.00
4	E. J. McKeever	5.75	66,125.00	8.75	13,125.00	.86	645.00	1.55	1,705.00
5	Thos. J. Regan	5.98	68,770.00	7.48	11,220.00	4.75	3,562.50	.85	935.00
6	Millard & Lahey	5.11	58,765.00	5.92	8,880.00	1.00	750.00	1.50	1,650.00
7	J. W. Hoffman & Co.	4.40	50,600.00	6.20	9,300.00	1.00	750.00	.80	880.00
8	The Wilson & Baillie Manufacturing Co.	5.30	60,950.00	5.88	8,820.00	1.00	750.00	.96	1,056.00
9	John J. Donovan	7.35	84,525.00	8.10	12,150.00	.75	562.50	2.07	2,277.00
10	William Morgan	3.88	44,390.00	5.89	8,835.00	1.40	1,050.00	.89	979.00
11	Manhattan Concrete Co.	4.80	55,200.00	13.50	20,250.00	.50	375.00	.60	660.00
12	Naughton & Co	5.35	61,525.00	6.20	9,300.00	.60	450.00	.70	770.00
13	Richard H. Brodhead	4.85	55,775.00	10.00	15,000.00	4.85	3,637.50	3.00	3,300.00
14	American Artificial Stone Pavement and Construction Co.	5.75	66,125.00	7.50	11,250.00	2.00	1,500.00	1.35	1,485.00
15	Stephens & O'Rourke	5.00	57,500.00	6.00	9,000.00	5.00	3,750.00	.75	825.00
16	Holmes & Cogan	6.00	69,000.00	7.00	10,500.00	1.50	1,125.00	1.60	1,760.00

No.	Name of bidder.	1,000 square yards granolithic pavement, American Portland cement mortar.		850 square yards asphalt waterproofing, in place.		45,000 brick laid in work.		45,000 pounds steel I-beams and channels, in place.	
		Per square yard.	Amount.	Per square yard.	Amount.	Per 1,000.	Amount.	Per pound.	Amount.
1	Irving A. Hodge	$1.50	$1,500.00	$0.20	$170.00	$20.00	$900.00	$0.02½	$1,237.50
2	John L. Grim	2.25	2,250.00	1.50	1,275.00	18.00	810.00	.03	1,350.00
3	Frank W. Molloy	2.00	2,000.00	.50	425.00	20.00	900.00	.03	1,350.00
4	E. J. McKeever	2.07	2,070.00	1.03	875.50	25.00	1,125.00	.02¾	1,237.50
5	Thos. J. Regan	1.85	1,850.00	.95	807.50	25.00	1,125.00	.04	1,800.00
6	Millard & Lahey	2.00	2,000.00	1.25	1,062.50	20.00	900.00	.04	1,800.00
7	J. W. Hoffman & Co.	1.20	1,200.00	.35	297.50	16.00	720.00	.02	900.00
8	The Wilson & Baillie Manufacturing Co.	1.08	1,080.00	.72	612.00	19.20	864.00	.03	1,350.00
9	John J. Donovan	3.00	3,000.00	1.40	1,190.00	17.50	787.50	.04	1,800.00
10	William Morgan	1.37	1,370.00	.33	280.50	18.90	850.50	.02 5/16	1,260.00
11	Manhattan Concrete Co.	1.50	1,500.00	1.00	850.00	15.00	675.00	.04	1,800.00
12	Naughton & Co	1.15	1,150.00	.90	765.00	23.00	1,035.00	.02 5/16	1,305.00
13	Richard H. Brodhead	3.00	3,000.00	1.50	1,275.00	16.00	720.00	.03	1,350.00
14	American Artificial Stone Pavement and Construction Co.	1.80	1,800.00	1.80	1,530.00	25.00	1,125.00	.03½	1,575.00
15	Stephens & O'Rourke	1.25	1,250.00	1.00	850.00	25.00	1,125.00	.04	1,800.00
16	Holmes & Cogan	2.00	2,000.00	.50	425.00	12.00	540.00	.03	1,350.00

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Abstract of proposals for the erection of a battery received in response to advertisement dated October 20, 1896, and opened November 28, 1896, etc.—Continued.

No.	Name of bidder.	6,450 pounds steel anchor bolts, with nuts and washers, in place.		400 feet 4-inch cast-iron pipe, set up.		300 feet iron pipe railing, set up.		150 pounds iron perforated covers for drains, in place.	
		Per pound.	Amount.	Per linear foot.	Amount.	Per linear foot.	Amount.	Per pound.	Amount.
1	Irving A. Hodge	$0.04	$258.00	$0.60	$240.00	$0.60	$180.00	$1.00	$150.00
2	John L. Grim	.06	387.00	.65	260.00	.35	105.00	.04	6.00
3	Frank W. Molloy	.05	322.50	.35	140.00	.50	150.00	.15	22.50
4	E. J. McKeever	.05½	354.75	.50	200.00	.25	75.00	.20	30.00
5	Thos. J. Regan	.07	451.50	.25	100.00	.35	105.00	.02	3.00
6	Millard & Lahey	.06	387.00	.50	200.00	1.00	300.00	1.50	225.00
7	J. W. Hoffman & Co.	.06	387.00	.35	140.00	.35	105.00	.04	6.00
8	The Wilson & Baillie Manufacturing Co.	.03½	225.75	.36	144.00	.31	93.00	.25	37.50
9	John J. Donovan	.05	322.50	.50	200.00	.20	60.00	.03	4.50
10	William Morgan	.09 9/10	632.10	.22	88.00	.21	63.00	.50	75.00
11	Manhattan Concrete Co	.05	322.50	.30	120.00	.20	60.00	.10	15.00
12	Naughton & Co	.04	258.00	.25	100.00	.25	75.00	.70	105.00
13	Richard H. Brodhead	.05	322.50	.40	160.00	.15	45.00	.05	7.50
14	American Artificial Stone Pavement and Construction Co	.09	580.50	.40	160.00	.25	75.00	.03	4.50
15	Stephens & O'Rourke	.05	322.50	1.00	400.00	.50	150.00	1.00	150.00
16	Holmes & Cogan	.05	322.50	.30	120.00	.20	60.00	.50	75.00

No.	Name of bidder.	150 feet 6-inch vitrified drain pipe, in place.		150 feet 4-inch vitrified drain pipe, in place.		15 single-leaf doors, with composition fittings, in place.		13 double-leaf doors, with composition fittings, in place.	
		Per linear foot.	Amount.	Per linear foot.	Amount.	Each.	Amount.	Each.	Amount.
1	Irving A. Hodge	$0.40	$60.00	$0.40	$60.00	$29.00	$435.00	$60.00	$780.00
2	John L. Grim	.70	105.00	.40	60.00	25.00	375.00	50.00	650.00
3	Frank W. Molloy	.30	45.00	.25	37.50	10.00	150.00	15.00	195.00
4	E. J. McKeever	.25	37.50	.20	30.00	35.00	525.00	20.00	260.00
5	Thos. J. Regan	.25	37.50	.20	30.00	12.00	180.00	15.00	195.00
6	Millard & Lahey	.25	37.50	.20	30.00	25.00	375.00	40.00	520.00
7	J. W. Hoffman & Co.	.25	37.50	.20	30.00	25.00	375.00	35.00	455.00
8	The Wilson & Baillie Manufacturing Co.	.24	36.00	.24	36.00	36.00	540.00	30.00	390.00
9	John J. Donovan	.25	37.50	.20	30.00	25.00	375.00	45.00	585.00
10	William Morgan	.14	21.00	.12	18.00	14.50	217.50	18.00	234.00
11	Manhattan Concrete Co	.30	45.00	.25	37.50	90.00	1,350.00	100.00	1,300.00
12	Naughton & Co	.18	27.00	.10	15.00	18.40	276.00	36.00	468.00
13	Richard H. Brodhead	.40	60.00	.30	45.00	20.00	300.00	25.00	325.00
14	American Artificial Stone Pavement and Construction Co	.30	45.00	.20	30.00	25.00	375.00	40.00	520.00
15	Stephens & O'Rourke	.30	45.00	.25	37.50	20.00	300.00	30.00	390.00
16	Holmes and Cogan	.20	30.00	.10	15.00	10.00	150.00	10.00	130.00

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Abstract of proposals for the erection of a battery received in response to advertisement dated October 20, 1896, and opened November 28, 1896, etc.—Continued.

No.	Name of bidder.	450 linear feet trolley line, including 20 trolleys.		6 hoists and fixtures in place.		6 steel cranes and fixtures in place.		1,800 cubic yards stone demolition, measured in place.	
		Per linear foot.	Amount.	Each.	Amount.	Each.	Amount.	Per cubic yard.	Amount.
1	Irving A. Hodge	$4.62	$2,079.00	$1,700.00	$10,200.00	$200.00	$1,200.00	$1.00	$1,800.00
2	John L. Grim	3.00	1,350.00	550.00	3,300.00	250.00	1,500.00	.90	1,620.00
3	Frank W. Molloy	3.50	1,575.00	500.00	3,000.00	300.00	1,800.00	.50	900.00
4	E. J. McKeever	2.00	900.00	500.00	3,000.00	300.00	1,800.00	1.00	1,800.00
5	Thos. J. Regan	3.90	1,755.00	595.00	3,570.00	295.00	1,770.00	1.85	3,330.00
6	Millard & Lahey	2.50	1,125.00	400.00	2,400.00	200.00	1,200.00	1.00	1,800.00
7	J. W. Hoffman & Co.	2.50	1,125.00	500.00	3,000.00	200.00	1,200.00	1.25	2,250.00
8	The Wilson & Baillie Manufacturing Co.	3.00	1,350.00	1,200.00	7,200.00	210.00	1,260.00	.60	1,080.00
9	John J. Donovan	4.00	1,800.00	377.50	2,265.00	200.00	1,200.00	1.00	1,800.00
10	William Morgan	3.75	1,687.50	750.00	4,500.00	250.00	1,500.00	1.36	2,448.00
11	Manhattan Concrete Co	.60	270.00	900.00	5,400.00	500.00	3,000.00	.50	900.00
12	Naughton & Co	4.00	1,800.00	520.00	3,120.00	212.00	1,272.00	.90	1,620.00
13	Richard H. Brodhead	3.70	1,665.00	100.00	600.00	300.00	1,800.00	1.50	2,700.00
14	American Artificial Stone Pavement and Construction Co.	.50	225.00	565.00	3,390.00	300.00	1,800.00	1.00	1,800.00
15	Stephens & O'Rourke	3.00	1,350.00	400.00	2,400.00	250.00	1,500.00	.40	720.00
16	Holmes & Cogan	1.20	540.00	80.00	480.00	400.00	2,400.00	.50	900.00

No.	Name of bidder.	2,000 cubic yards earth excavation, measured in place.		27,000 cubic yards sand filling, measured in place.		Total amount.
		Per cubic yard.	Amount.	Per cubic yard.	Amount.	
1	Irving A. Hodge	$0.20	$400.00	$0.25	$6,750.00	$94,829.50
2	John L. Grim	.25	500.00	.25	6,750.00	97,303.00
3	Frank W. Molloy	.12	240.00	.15	4,050.00	*78,202.50
4	E. J. McKeever	.20	400.00	.15	4,050.00	100,870.25
5	Thos. J. Regan	.25	500.00	.43	11,610.00	113,707.60
6	Millard & Lahey	.30	600.00	.18	4,860.00	89,867.00
7	J. W. Hoffman & Co	.25	500.00	.18	4,860.00	79,118.00
8	The Wilson & Baillie Manufacturing Co	.48	960.00	.36	9,720.00	98,554.25
9	John J. Donovan	.75	1,500.00	.10	2,700.00	119,171.50
10	William Morgan	.30	600.00	.29	7,830.00	78,929.10
11	Manhattan Concrete Co	.22	440.00	.12	3,240.00	98,810.00
12	Naughton & Co	.18	360.00	.14	3,780.00	89,576.00
13	Richard H. Brodhead	.50	1,000.00	.25	6,750.00	99,837.50
14	American Artificial Stone Pavement and Construction Co	.30	600.00	.40	10,800.00	106,795.00
15	Stephens & O'Rourke	.25	500.00	.20	5,400.00	†89,765.00
16	Holmes & Cogan	.10	200.00	.20	5,400.00	95,522.50

*Lowest bid. †$1,200 each for hoists with electric motors.

Contracts in force.

With Walter C. Butler, dated September 1, 1896, approved by the Chief of Engineers September 10, 1896, for furnishing 12,000 barrels "Old Newark" Rosendale cement, at 74.8 cents per barrel. Deliveries began September 7, 1896, and were completed December 1, 1896.

With Jacob E. Conklin, dated September 1, 1896, approved by the Chief of Engineers September 14, 1896, for furnishing 7,500 cubic yards of small, broken trap rock, at $1.29 per cubic yard. Deliveries began September 6, 1896, and were completed December 1, 1896.

With Frank W. Molloy, dated December 18, 1896, approved by the Chief of Engineers January 5, 1897, for the erection of concrete battery for three 10-inch guns, work to begin April 1, 1897, and to be completed November 1, 1897. Estimated cost $78,202.50.

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3 G.

DEFENSES OF THE DELAWARE RIVER.

Officer in charge, Maj. C. W. Raymond, Corps of Engineers, with First Lieut. Spencer Cosby, Corps of Engineers, under his immediate orders.

BATTERY FOR 10-INCH AND 12-INCH DISAPPEARING GUNS AND 5-INCH R. F. GUNS.

Battery for disappearing guns.—The approved project under which work is being carried on provides for the construction of three emplacements for 12-inch disappearing guns, three emplacements for 10-inch disappearing guns, and two emplacements for 5-inch rapid-fire guns. The estimated cost of the three 12-inch emplacements was $168,400; that of the three 10-inch emplacements, $120,000, and that of the two 5-inch emplacements, $20,000. In addition, a parados is to be erected, at an estimated cost of $13,750, and a road is to be built, to cost $3,500. On February 29, 1896, the Chief of Engineers authorized to be applied to the construction of the 10-inch emplacements the sum of $70,000, from the allotment made August 11, 1894, for a three-gun lift battery from the appropriation for gun and mortar batteries, act of August 1, 1894. On July 1, 1896, an additional sum of $274,680 was allotted to complete the entire battery from the appropriation for gun and mortar batteries, act approved June 6, 1896.

On November 25, 1896, $25,000 was withdrawn from this allotment.

All materials have to be brought by water, usually from Philadelphia, Wilmington, or New York, and landed at the Government wharf. This is an old crib structure, 24 feet wide, extending 550 feet into the river. Its head was originally 35 feet long and 48 feet wide, but was extended 30 feet to the front in July, 1896. Even now the space available for unloading materials is found to be inadequate. There is an available low-water depth of 9 feet around the head of the wharf. Part of this depth had to be obtained by dredging.

The east end of the main battery lies on a level site in the line of prolongation of the wharf and over 1,200 feet from its head. The battery consists of three emplacements for 12-inch disappearing guns on its right flank and of three emplacements for 10-inch disappearing guns on its left flank. The 10-inch guns are mounted on Buffington-Crozier disappearing carriages, model of 1894, and the 12-inch guns are to be mounted on the new 1896 model carriages. The emplacements for both the 10-inch and the 12-inch guns are of the same general design, which differs somewhat from that of any of the typical emplacements of The Board of Engineers. The parapet wall of the battery is a single straight wall of concrete without a bulge or break in its entire length. The foundations are carried from 2½ to 3½ feet below the level of the magazine floors. Despite the large measure of protection afforded, the total amount of concrete in the three 10-inch emplacements, including the wing wall, is only 15,606 cubic yards, and in the three 12-inch emplacements is 21,918 cubic yards. The amount of concrete in all the emplacements is increased by the necessity of giving a greater thickness to the walls in rear of the magazines in order to protect them from a reverse fire to which they would be subject from ships which might succeed in running past the battery. In each emplacement there is a single ammunition lift, which connects with the loading platform by a short passage opening to the rear and protected by a slight extension of the traverse into the corner formed by its junction

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with the parapet. The shot chamber under the loading platform is a single curved room with a rear wall of brick, and connects directly with the lift and magazines.

Before definitely deciding upon the location of the battery a careful topographical survey was made of the site, and five wells were dug to determine the nature of the soil. This was found to consist of about 3 feet of yellow loam underlaid by a stratum of clay, below which is a bed of sand. It was decided to excavate to the level of the clay for the foundations. By driving well points 15 or 20 feet below the surface a supply of water was obtained ample for all purposes. This water was pumped into an old iron cistern which was brought over from Fort Delaware and placed upon a wooden scaffolding at such a height as to give a good pressure at all parts of the work. Pipes run from the cistern to the head of the wharf, to the mixers, and to a number of points along the line of the battery.

The site of the battery was cleared by removing from it buildings and trees. Excavating for the foundations of the battery was begun on May 27, 1896. Machinery, derricks, cars, railroad track, tools, etc., purchased for use at Fort Delaware at an aggregate cost of $9,857.56, were transferred to the battery, and form a large part of the construction plant. The concrete plant has three mixers, the first of which was started on June 3, 1896, the second on July 21, 1896, and the third on October 8, 1896. The plant is arranged as follows: At the head of the wharf is a double-drum hoisting engine operating four derricks, which unload materials from boats to cars running on tracks of 3-foot gauge. There are two lines of track on the wharf, branching into four at its head. One line leads up an inclined trestle to the bins for small broken stone and sand, and it is used only for these two materials; the other leads past the cement shed to the battery and is used for all materials except the two just mentioned. Cars are hauled over both tracks by cables, which are operated by drums in the engine house. This is a temporary frame structure near the east end of the battery and contains the following machinery, which was in constant use during active operations:

One 50-horsepower vertical boiler, furnishing steam to five engines, viz, one 15-horsepower single-cylinder horizontal engine running two concrete mixers; two 12-horsepower three-drum tandem engines used for operating cable ways and derricks and for hauling mixing cars from the tunnels under the storage bins to the top of the mixer platforms; one 30-horsepower single-drum cable engine for hauling sand and broken stone from the wharf to bins in rotary dump cars of 3 cubic yards capacity each, and one duplex pump for pumping water from the well points to the cistern.

The bins are in the line of prolongation of the wharf, a few yards in front of the engine house. They have a capacity of 1,000 cubic yards of broken stone and 400 cubic yards of sand. The cement shed is opposite the bins, and holds 6,000 barrels. Two mixers are placed on platforms opposite the end of the bins near the engine house. The third mixer is placed at the opposite end of the bins. A single-drum hoisting engine runs it, and hauls the mixing car up the incline leading to the platform above the mixer. On the average, two mixers may be said to have been in daily use while concrete was being laid. Two double-drum hoisting engines, moved from place to place as necessity required, were used for operating the derricks which swung the charges of concrete and the large stones into place and unloaded the latter from the cars.

The derricks were strung along in front of the battery and on top of

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the parapet as it was erected. Two with 80-foot masts and 70-foot booms, and two with 54-foot masts and 45-foot booms, were in constant use during the whole period of construction. Two additional ones of the larger size were in use after September 26 and October 24, 1896, respectively.

An elevating apparatus, manufactured by the Exeter Machine Works, and consisting essentially of an endless chain of steel buckets emptying into a small bin, was erected at the head of the wharf for the purpose of unloading sand and small broken stone from scows. But little use has been made of it, and it has not been paid for, as it has so far failed to meet the requirement of the specifications under which it was purchased that it should be capable of handling 50 cubic yards of material per hour.

Concrete was all machine mixed. Each mixer consists of a cubical box 4 feet on edge, rotated on a shaft passing through diagonally opposite corners by spur gearing controlled by a friction clutch; one end of the mixer shaft is hollow for the introduction of the requisite quantity of water to the center of the charge. The mixers are given about 9 turns per minute and from 18 to 20 turns for each charge of concrete. This measures loose 34½ cubic feet, and in place 27.4 cubic feet, and is composed of 1½ barrels of Rosendale cement, 10½ cubic feet of sand, and 26¼ cubic feet of 1½-inch broken granite. When Portland concrete is mixed, the same proportions of sand and stone are retained, but only 1 or 1¼ barrels of cement are used, depending upon the part of the work in which the charge is to be placed. Cement mortar is similarly mixed. The placing of the concrete began on June 3, 1896, and was suspended for the winter on December 15, 1896, 24,671 cubic yards having been placed in that period. The mixers were started again on March 23, 1897, and the last charge was put in place and the masonry of the battery completed on June 23, 1897.

The emplacements are built of Rosendale concrete, with the exception of the brick walls in rear of the platforms and of the platforms themselves, which are largely composed of Portland concrete. Seven thousand two hundred and eighty-one and thirty-seven hundredths tons of irregular granite stones, weighing from 250 to 6,000 pounds each, are scattered through the concrete. All exterior concrete walls, as well as the tops of the magazines, the platforms, and the circular steps leading to them, are faced with 2½ inches of Portland mortar mixed in the proportion of 1 part of cement to 3 parts of sand. All interior concrete surfaces are faced with 2½ inches of Rosendale mortar, composed of 1 part of cement and 2 parts sand. The superior slope is covered with a layer of Portland concrete, from 3 to 8 inches thick, according to its distance from the muzzle of the gun; over this layer is placed another of Portland mortar, from 3 to 4 inches thick as a rule. Those portions of the mortar layer which lie directly under the blast of the gun are composed of 1 part cement to 2 parts sand; the other portions are mixed in the proportion of 1 to 3.

The ceilings of the rooms and passages are supported by steel I-beams placed 2 feet apart; their ends set 6 inches into the wall on each side and rest upon small iron plates. In the magazines and passages the concrete between the beams is arched with a rise of 5 inches. The size of beams to be used was determined in most cases by assuming that the concrete ceiling would be self-supporting if built in the form of a full center arch, and hence that the weight to be carried by the beams would be that of the concrete between this arch and the actual plane of the ceiling. No deflection greater than one-fourth of an inch has

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been found in any of the beams, and this amount only in the largest and longest ones. In the shot chamber under the loading platform the beams are designed to support the full weight of the masonry above them plus 1 ton allowed for men and ammunition on the loading platform. The concrete between the beams is not arched, but is supported on corrugated iron; to prevent the condensation of moisture on this, it is covered with "cork paint," similar to that used for the same purpose in the Navy. The iron is first coated with a kind of thick sizing, against which powdered cork is then thrown; after drying, this is covered with a coat of white lead to make the room lighter.

Air spaces, 4 inches wide and 1 foot back from the faces of the walls, were placed around the magazines and passages of three of the four emplacements built before December, 1896. They were left out of the fourth emplacement. All have been carefully observed since, and no difference has ever been found in the degree of dryness of the four emplacements. No leakage of water into any of the magazines or passages has been noticed, the only moisture ever found being due to condensation. In view of these facts the air spaces were omitted from the last two emplacements.

The parapet in front of the concrete wall is composed partly of earth taken from the excavation for the foundations, and partly of unwashed river sand purchased for the purpose; a large part of this embankment was placed during the winter when concrete work was suspended. The material was thoroughly rammed in layers about a foot thick; the whole was covered with a foot of loam, and this sown with a mixture of rye, blue grass, orchard grass, and white clover seed.

A permanent roadway, not yet completed, runs from the wharf to and along the rear of the battery. It is covered with sand and broken stone, and has a railroad track on one side and a brick gutter on the other.

About 100 feet behind the battery, and along the entire rear, is to be thrown up an earthen parados to protect it from the reverse fire to which it might be subjected. The material for the parados is to be excavated from a ditch alongside of it and connected with the river by a sluice gate. Into this ditch is to empty the 12-inch sewer pipe laid along the rear of the battery, and into which its drainage is carried.

A double, curved, iron stairway leads from the roadway to each platform. The steps from the shot chamber to the platform are of concrete with cast-iron treads. All doors are 2§ inches thick, made up of three thicknesses of seasoned yellow-pine boards, fastened together with brass screws. The hinges, gudgeons, and bolts are of bronze, and large Yale mortise locks are used. Each lock has a different key, but there is a master key which will open any door in the battery.

Two steel cranes, with Yale-Weston triplex pulley blocks, stand in rear of each platform. In each emplacement two lines of overhead trolley rails, consisting of 5-inch steel I-beams, run from the shell magazine and from the shot chamber to the ammunition hoist. This is built up of steel, and has firmly secured to its sides brass trays of sufficient capacity to contain two complete charges of powder. At its top are two 5-inch I-beams. When the hoist is lowered, each of these comes into exact prolongation of the line of trolley rails from the magazine on one side and of that from the shot chamber on the other.

The projectiles are pushed on trolleys to the hoist, the powder bags are placed on the trays by hand, and the hoist is then raised to the loading platform. Here its trolley rails come into prolongation of two others which bring the projectiles directly over the ammunition truck

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under cover of a short passage in the traverse; in this way the truck never leaves the loading platform. The hoist can be worked either by hand power or by electricity. A 5-horsepower series motor operates each 10-inch hoist and a 7½-horsepower motor each 12-inch hoist. The whole battery is lighted by electricity, the lighting and motor circuits being entirely independent of each other. All wires are placed in iron-armored insulating conduits where they pass through concrete walls and through magazines and passages in which powder is to be carried. In the shot chambers they are simply strung along the ceiling, being held by porcelain cleats. Cut-outs, contained in insulated iron boxes, are placed wherever there is a change in the size of the wires. A second circuit is placed in an underground terra-cotta conduit along the rear of the battery, connecting through switches with the interior circuits of each emplacement. It is intended to be used in case of damage to the interior circuit at any point or during a temporary breakdown of the latter. The incandescent lamps in the magazines are placed in glass globes surrounded by wire guards and are lighted by means of switches outside the magazine doors. In addition to the electric lights lamp recesses, in which are placed Dietz tubular lanterns, have been built at short intervals into the walls of the shot chambers and passages. The magazines are lighted in this alternative system by lanterns in the wall opposite their doors.

The electric plant is placed in a room 16 by 30 feet in the west end of the battery. It consists of two 25-kilowatt dynamos, each directly connected to an Ames engine; two 50-horsepower boilers, a switchboard, a Worthington pump, a feed-water heater, and a Sturtevant blower. The plant has ample power to run the hoists and lights in the main battery as well as those in the four 5-inch rapid-firing gun emplacements yet to be built. An iron cistern having a capacity of 2,800 gallons has been built into the top of the concrete wall in rear of the dynamo room. It is supplied with water by the feed pump in the boiler room, and from it a pipe leads to a faucet in rear of each gun platform. The supply of water for the boilers is contained in a cistern 2½ feet deep, with a capacity of 1,050 gallons, built into the concrete floor of the passage leading to the boiler room. The water for both this cistern and the iron tank above is pumped from well points driven opposite the entrance to the passage.

An observation station is located at each end of the battery; that at the west end has a relocating room beneath it. Iron ladders lead from each platform to the superior slope. Speaking tubes connect each platform with the passage leading to its magazine and with the adjacent platform. A manhole has been built in each 10-inch platform, leading to the bottom of the counterweight well. A manhole into which the underground conduits open and a separate one into which the drainage pipes lead have been built in rear of each emplacement.

The three 10-inch guns and carriages were mounted by December 21, 1896.

The following shows the average distribution of employees during active operations by gangs and the work accomplished by each gang:

(*a*) Unloading building sand and small broken stone from scows, and hauling to storage bins: 1 master laborer, at $2.50 or $3 per day; 1 engineer, at $60 per month; 1 fireman, at $45 per month; 1 fireman running cable engine, at $45 per month; 15 laborers, at $1.40 per day. Total amount of small broken stone handled, 29,656.23 cubic yards; 1,298 hours of work, considering the above gang as a unit. Average amount of stone handled per day of eight hours, 182.8 cubic yards. Total amount of sand handled, 11,575.66 cubic yards; 429 hours of work, considering the above gang as a unit. Average amount of sand handled per day of eight hours, 215.9 cubic yards.

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(*b*) Unloading from scows, hauling and storing large broken stone (work not continuous): 1 master laborer, at $2.50 per day; 1½ engineers, at $60 per month; 1½ firemen, at $45 per month; and 12 laborers, at $1.40 per day. Total amount of large broken stone handled, 7,281.37 tons; 346 hours of work, considering the above gang as a unit. Average amount handled per day of eight hours, 168.4 tons.

(*c*) Unloading from schooners, hauling, and storing cement (work not continuous): 2 master laborers, at $2.50 per day; 1 engineer, at $60 per month; 2 firemen, at $45 per month; and 23 laborers, at $1.40 per day. Total amount of cement handled, 57,879 barrels; 409 hours of work, considering the above gang as a unit. Average number of barrels handled per day of eight hours, 1,132.

(*d*) Excavation for foundations: This was done by the gangs from the wharf at odd times when not engaged in unloading construction materials, and the number of men employed varied accordingly. Total number of hours of labor, 14,547. Total number of cubic yards handled, 6,650. Average number of cubic yards per man per day of eight hours, 3.66.

(*e*) Unloading from scows, hauling, and placing sand for filling embankment in front of battery: 2½ master laborers, at $2.50 per day; 3 engineers, at $60 per month; 3 firemen, at $45 per month; and 32 laborers, at $1.40 per day. Total amount of sand handled, 13,796.14 cubic yards; 495 hours of work, considering the above gang as a unit. Average amount handled per day of eight hours, 222.98 cubic yards.

(*f*) Concrete work: Gang for one mixer—1 master laborer, at $3 per day; 1½ engineers, at $60 per month; 1 fireman, at $45 per month; 1 laborer attending mixer, at $45 per month; 2 laborers in tunnel loading car, at $1.60 per day; 1 laborer filling mixer, at $1.40 per day; 2 laborers under mixer, at $1.40 per day; 2 laborers on cement platform filling hopper, at $1.40 per day; 4 laborers attending derrick, at $1.40 per day; 8 laborers placing and ramming, at $1.40 per day. Total amount of concrete placed in parapet and traverses, 33,387 cubic yards, including pavements; 3,208 hours of work, considering the above gang as a unit; average per day of eight hours, 83.26 cubic yards. Total amount of concrete placed in gun platforms, 3,890 cubic yards; 838 hours of work, considering the above gang as a unit; average per day of eight hours, 37.13 cubic yards.

(*g*) Carpenter work of all kinds: 1 master carpenter, at $3.50 per day; 10½ carpenters (average), at $2.50 per day. Above gang of carpenters engaged in building and setting up forms, building magazine doors, extending wharf, and general repairs to plant.

(*h*) Riggers' work: 1 master rigger, at $3 per day; 6½ riggers (average), at $1.75 per day. Above gang engaged in moving and setting up derricks, moving and mounting guns and carriages, and general rigging work.

(*i*) Track work: 1 track man, at $2.50 per day, with a gang of from 4 to 12 laborers, at $1.40 per day, building and shifting tracks, and on general work.

(*j*) Blacksmith work: 1 blacksmith, at $3 per day, and helper, at $1.75 per day, at general iron work in connection with construction of battery.

(*k*) Bricklaying: 1 master brick mason, at $3.75 per day; 4½ masons (average), at $3.25 per day; and 3 laborers, at $1.40 per day; building rear walls of shot chambers and manholes for sewers and conduits and setting gudgeons for magazine doors.

(*l*) Painting: 3 painters, at $2.25 per day; 1 laborer, at $1.40 per day; painting guns and carriages, stairways, and ceilings of shot chambers.

(*m*) Machinists: 2 machinists, at $2.80 per day; 1 master engineer, at $90 per month; 2 laborers, at $1.75 per day; 3 to 12 laborers, at $1.40 per day; erecting stairways, putting in shot hoists, trolley system, and ammunition cranes, setting up machinery for electric light and power plant, etc.

(*n*) Office force: 1 superintendent, at $200 per month; 1 draftsman and 1 overseer, at $125 per month each; 1 clerk, at $90 per month; 1 recorder, 1 assistant recorder, and 1 cement tester, at $50 per month each; 1 laborer, at $40 per month; care of office and storeroom.

(*o*) Crew of launch: 1 master, at $75 per month, and 1 engineer, at $60 per month; running launch.

Quantity of each class of material used and average cost delivered on or alongside of wharf:

5,471 barrels Portland cement, per barrel	$2.0468
47,545 barrels Rosendale cement, per barrel	.8287
29,156 cubic yards small broken stone, per cubic yard	1.2188
7,281 tons large broken stone, per ton	.8794
11,126 cubic yards building sand, per cubic yard	.5445
13,796 cubic yards sand for embankment, per cubic yard	.295
123,391 pounds steel I-beams and channels, per pound	.0185
1,292 feet 5-inch I-beams for overhead trolley rails of ammunition service, per foot	.326
12,243 pounds corrugated iron for ceilings in shot chambers under loading platforms, per pound	.0399

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27,082 pounds anchor bolts for platforms, per pound	$0.0494
119,828 bricks for rear walls of shot chamber, per M	11.8111
17,850 bricks for gutters of roadway, per M	9.50
203,512 feet B. M. yellow-pine lumber, per 1,000 feet	16.3145
19,315 feet B. M. hemlock lumber, per 1,000 feet	15.1038
9,400 feet B. M. Georgia yellow-pine lumber, kiln dried, for doors, per 1,000 feet	41.286
5,798 pounds bronze hinges and gudgeons for doors, per pound	.3128
419 gross brass screws for doors, per gross	.7691
3 ammunition hoists, with motors, complete, for 10-inch emplacements, each	698.00
3 ammunition hoists, with motors, complete, for 12-inch emplacements, each	747.00
12 ammunition cranes, complete, with hoisting blocks, each	91.25
6 iron stairways, each	272.00
6 sets of guard rails for loading platforms, per set	57.00
Machinery for electric light and power plant	5,126.91
24 trolleys with hoisting blocks for ammunition service, each	47.00
17 manholes and covers, each	11.5588
1,660 feet interior conduit, ½ to 2 inches	182.50
2,000 feet underground conduit, per foot	.10
7,654 feet insulated wire, No. 14 to 300,000 c. m	940.28
545 feet galvanized iron pipe for speaking tubes, per foot	.0522
2,506 feet vitrified sewer pipe, 4 to 12 inches	246.51
991 feet cast-iron drainpipe, 4 inch, per foot	.0203

AVERAGE COST OF HANDLING MATERIALS.

Cement, per barrel:	
Unloading into cars	$0.0249
Hauling to and storing in shed	.0212
Small broken stone, per cubic yard:	
Unloading into cars	.1648
Hauling to and storing in bins	.0437
Large stone, per ton:	
Unloading into cars	.1283
Hauling to and storing in front of work	.0974
Placing in walls	.1375
Building sand, per cubic yard:	
Unloading into cars	.1275
Hauling to and storing in bins	.0521
Sand for embankment, per cubic yard:	
Unloading into cars	.145
Hauling to and placing in embankment	.155
Bricks per 1,000, unloading, hauling, and storing	1.879
Excavation per cubic yard	.4675
Setting anchor bolts, each	.912
Setting ammunition cranes, each	10.89

AVERAGE COST OF MATERIALS IN PLACE.

Concrete masonry in parapet and traverses, 32,587.13 cubic yards, per cubic yard:	
Framing (labor, lumber, nails, etc.)	$0.1921
Materials (cement, sand, small and large broken stone)	2.8387
Mixing	.1855
Placing and ramming	.3474
Finishing face walls and pavements	.0572
Total per cubic yard	3.6209
Concrete masonry in gun platforms, 3,890.48 cubic yards, per cubic yard:	
Framing (labor, lumber, nails, etc.)	.3385
Materials (cement, sand, and stone)	3.7648
Mixing	.3332
Placing	.6389
Total per cubic yard	5.0754

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Portland cement pavement on superior slope and tops of traverses, 800 cubic yards, per cubic yard:	
Setting forms	$0.4778
Materials (cement, sand, and stone)	5.03
Mixing and placing	1.7422
Total per cubic yard	7.25
Brick masonry in circular rear walls of shot chambers, 246.3 cubic yards, per cubic yard:	
Materials (brick and cement)	8.3828
Labor laying bricks	15.3363
Total per cubic yard	23.7191
80-foot derricks, complete, each	442.76
Overhead trolley system, 10-inch emplacements, each	401.77
Iron stairways, 10-inch emplacements, each	369.60
Sand in embankment, per cubic yard	.595
Doors, each	43.49
Total cost of work to June 30, 1897:	
32,587.13 cubic yards concrete masonry in parapet and traverses, at $3.6209 per cubic yard	117,994.74
3,890.48 cubic yards concrete masonry in gun platforms, at $5.0754 per cubic yard	19,745.74
800 cubic yards Portland cement pavement on superior slope and tops of traverses, at $7.25 per cubic yard	5,800.00
246.3 cubic yards brick masonry in rear walls of shot chambers, at $23.7191 per cubic yard	5,842.01
6,650 cubic yards of excavation for foundations, at $0.4675 per cubic yard	3,108.88
13,796.14 cubic yards of sand for embankment in front of battery, at $0.595 per cubic yard	8,208.70
Clearing site for battery	475.76
Repair and extension of wharf	1,961.38
Purchase, construction, and installation of plant	10,077.63
Apparatus on wharf for unloading materials	1,930.69
Electric light and power system (installation not yet completed)	7,316.39
System for service of ammunition (installation not yet completed)	3,778.56
Drainage system	1,597.95
Speaking-tube system	45.92
Anchor bolts, 27,082 pounds, at $0.0564 per pound	1,527.42
I-beams, corrugated iron, stairways, doors, etc	10,688.95
Mounting guns and carriages	2,478.40
Cleaning, oiling, and painting guns and carriages	230.15
Grading and seeding embankment	1,332.08
Repair and maintenance of plant and purchase of material for operating purposes	9,956.17
Engineering, supervision, office expenses, and contingencies	10,944.74
Maintenance and repair of launch for mail service	2,262.38
Miscellaneous items, including time allowed employees for legal holidays	1,916.10
Permanent roadway (not yet completed)	1,701.51
Plant for permanent water supply (not yet completed)	287.63
Work on parados (just begun)	128.52
Total cost to June 30, 1897	231,338.40
Amount expended on rapid-fire battery	1,173.53
Value of construction materials on hand	5,819.87
Value of miscellaneous supplies on hand	1,751.44
Total	240,083.24

RESULTS.

The main battery proper is practically completed. The three 10-inch guns are mounted in position, and the three 12-inch guns can be mounted as soon as the guns and carriages are received.

The six emplacements contain, all told 37,523.91, cubic yards of concrete masonry, and the embankment in front contains 20,970.14 cubic yards of sand and earth.

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The work still to be done consists in building the parados and road in rear of battery; in completing the installation of the systems for electric lighting and for the service of ammunition, and in finishing up minor details about the work. All materials required are on hand, so that no delays are anticipated.

Battery for 5-inch rapid-fire guns.—Two emplacements for 5-inch rapid-fire guns on balanced pillar mountings are to be built about 100 feet beyond the western end of the main battery. The project for the construction of these emplacements, at an estimated cost of $20,000, was approved June 3, 1897, the work to be done with funds on hand.

Excavation for the foundations began on June 8, 1897, and was nearly completed on June 30, 1897. The placing of concrete will be begun at once, and it is estimated that the two emplacements can be ready to have the guns mounted in them by August 15, 1897.

Money statement.

July 1, 1896, balance unexpended		$56,903.73
July 1, 1896, additional allotment		274,680.00
		331,583.73
November 25, 1896, withdrawn from allotment		25,000.00
		306,583.73
June 30, 1897, amount expended during fiscal year		199,836.20
July 1, 1897, balance unexpended		106,747.53
July 1, 1897, outstanding liabilities	$17,751.54	
July 1, 1897, amount covered by uncompleted contracts	20,552.58	
		38,304.12
July 1, 1897, balance available		68,443.41

Lists of all contracts in force, with names of contractors, date of approval, of beginning work, and expiration.

1. With the Brandywine Granite Company, Wilmington, Del., dated August 25, 1896, approved September 14, 1896, for furnishing and delivering 25,000 cubic yards of small broken stone, at $1.32 per cubic yard, and 9,000 tons of large broken stone, at 90 cents per ton of 2,240 pounds. First delivery to be made before August 31, 1896; final delivery to be made before July 1, 1897.

2. With Robert Patterson & Son, Philadelphia, Pa., dated November 13, 1896, approved November 21, 1896, for furnishing and delivering 18,000 cubic yards of sand for filling, at 29½ cents per cubic yard. First delivery to be made between November 20 and December 10, 1896; final delivery to be made between June 1 and August 31, 1897.

3. With the Bullock Electric Manufacturing Company, of Cincinnati, Ohio, dated March 30, 1897, approved May 28, 1897, for furnishing and delivering materials for an electric light and power plant, at a total cost of $5,089; all the materials to be delivered before May 20, 1897. Materials were delivered May 29, 1897.

4. With Oliver Crosby, of St. Paul, Minn., dated March 8, 1897, approved March 30, 1897, for furnishing and delivering six ammunition hoists, at a total cost of $4,335; final delivery to be made before May 20, 1897. Materials were delivered May 29, 1897.

Battery for 12-inch disappearing guns.—It is proposed to construct a battery on a pile foundation for three 12-inch disappearing guns. This project was approved July 2, 1896, and takes the place of the original project under which the work was begun for a three-gun lift battery. For the construction of the latter the sum of $260,000 was, on August 11, 1894, allotted from the appropriation of August 1, 1894, for gun and

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mortar batteries. On July 30, 1895, $50,000 was withdrawn from this allotment, and on February 29, 1896, $70,000 more was withdrawn.

With the $140,000 thus left available it was estimated that, after the purchase of the necessary plant and the completion of various necessary preliminary operations, all of the piles for the foundations of the approved battery, 4,622 in number, could be driven.

The estimated cost of the battery for three 12-inch disappearing guns is $357,200, of which $140,000 has so far been allotted.

The preliminary work on the foundations of this battery began on December 11, 1894. A report of what had been accomplished up to the beginning of the fiscal year ending June 30, 1896, is contained in the Annual Report of the Chief of Engineers for that year, pages 483 to 486.

The only work done since then during the fiscal year just ended has been the practical completion of the driving of the piles for the foundations. Pile driving was resumed on December 29, 1896, and was discontinued on March 30, 1897, 772 piles having been driven during the intervening period. This makes 4,582 piles in all that have been driven for the foundations out of a total of 4,622 required. The remaining 40 piles have to be driven in casemates 26 and 27 on Front 3; the piles are on hand and could be driven in four or five days. As a small pile driver would have to be specially set up for the purpose, it was thought to be more economical to postpone the driving until work on the battery is actively resumed. A large portion of the plant, costing nearly $10,000, purchased for use in the construction of this battery, was used in constructing the battery for three 12-inch and three 10-inch guns. The remaining plant is still in good condition, and now that the driving of the piles is practically finished, the construction of the battery proper can be begun and carried rapidly to completion as soon as funds are available. The small balance from the present allotment is to be applied to the construction of a mortar battery.

The pile heads will be kept covered with water to preserve them as much as possible. This large pool of water inside the fort renders its condition very unsanitary, and would, it is believed, be a serious menace to the health of any troops stationed there.

Money statement.

July 1, 1896, balance unexpended	$20,696.90
June 30, 1897, amount expended during fiscal year	13,190.34
July 1, 1897, balance unexpended	7,506.56

Cable tank.—On November 5, 1896, the sum of $1,600 was allotted from the appropriation for torpedoes for harbor defense, act of June 6, 1896, for the construction of a tank for the wet storage of submarine cables. The work of construction began on February 13, 1897, and the tank was completed on April 30, 1897, at a cost of $1,600. To handle the reels of cable an overhead traveling crane having a span of 28 feet 8 inches and a capacity of 3 tons was erected over the tank. A track, over which it is intended to bring the reels on cars, leads from the wharf into the tank.

Money statement.

November 5, 1896, amount allotted	$1,600.00
June 30, 1897, amount expended during fiscal year	1,600.00

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No contracts have been entered into under this allotment.

Torpedo shed.—On March 30, 1897, the sum of $7,200 was allotted from the appropriation for torpedoes for harbor defense, act of June 6, 1896, for the construction of a fireproof building for the storage of torpedo materials. The building is to be of brick on a grillage foundation and is to be erected just outside the fort opposite bastion 3–4. The plans have been approved, all the materials ordered, and most of them delivered. Owing to the failure of the contractor for the timber for the grillage foundation to deliver it on time, it has been impossible as yet to start the work of construction. This will be begun as soon as the timber is received.

Money statement.

March 30, 1897, amount allotted	$7,200.00
June 30, 1897, amount expended during fiscal year	866.53
July 1, 1897, balance unexpended	6,333.47
July 1, 1897, outstanding liabilities	1,939.70
July 1, 1897, balance available	4,393.77

No formal contracts have been entered into under this allotment.

Mortar battery.—It is proposed to construct a battery for sixteen 12-inch mortars at an estimated cost of $247,180. On June 4, 1897, the sum of $175,000 was allotted by the Chief of Engineers for the construction of this battery from the appropriation for "Gun and Mortar Batteries," act of March 3, 1897; in addition, the use was authorized of any balances from the allotments for other works.

As soon as the allotment was received specifications were issued and proposals were advertised for for the principal construction materials needed. Very little new plant will be required, as it is proposed to make use of that now on hand. The wharf leading to the reservation is in a dilapidated condition, and at its head there is a depth of water of only a little over a foot at low tide. It is proposed to extend it 336 feet into the river, and this will have to be done before work on the battery can be commenced. The lumber, piles, and other materials needed for the extension have been purchased, and over half the piles have already been driven. The work is being pushed rapidly, and as soon as possible part of the plant at another work will be transferred to the Delaware shore and erected and the construction of the battery begun.

Money statement.

June 4, 1897, amount allotted	$175,000.00
July 1, 1897, balance unexpended	175,000.00
July 1, 1897, outstanding liabilities	98.98
July 1, 1897, balance available	174,901.02

No bids under the allotment for this battery have yet been opened or contracts entered into.

FORT MIFFLIN, DELAWARE RIVER, PENNSYLVANIA.

Considerable damage was done to the wharf and meadow banks at this reservation by the storms of August 24 and 28, 1893, and additional damage was done to the banks by the storms of April 10, 1894, and February 6–7, 1896.

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The river and harbor act of June 3, 1896, required the expenditure of $3,000 from the appropriation for improving Delaware River, in rebuilding and enlarging the dike on this reservation at the junction of the Schuylkill and Delaware rivers.

Under date of October 7, 1896, contract was entered into with James J. Cowgill, of Paulsboro, N. J., for the required reconstruction and extension. Work under this contract was completed in December, 1896. The dike on the northeastern side of the reservation, extending from high ground at the old Lazaretto for a distance of 1,800 feet along the Schuylkill River front, and an additional distance of 300 feet along the Delaware River front, was rebuilt and repaired. The top is now 10 feet above mean low water and has a width of 12 feet. The interior face has a slope of 1 on 2 and the stone revetment on the exterior slope has been relaid and raised to the full height of the dike.

Money statement.

July 1, 1896, balance unexpended	$3,000.00
June 30, 1897, amount expended during fiscal year	2,428.40
July 1, 1897, balance unexpended and avalable	571.60

SITE FOR DEFENSES AT REDBANK, N. J.

The meadow banks of this reservation were breached by the storm of October 13, 1893, and th property of the United States and adjoining properties were overflowed. The ebb and flow of the tides through the breaks in the banks do no injury to the property of the Government.

The river and harbor act of June 3, 1896, required the expenditure of $2,500, or so much thereof as might be necessary, from the appropriation for improving Cooper Creek, New Jersey, in rebuilding the dike on this reservation on the Delaware River and Woodbury Creek.

Under date of October 7, 1896, contract was entered into with Frank C. Somers, of Camden, N. J., for rebuilding the dike on the Government reservation at Woodbury Creek. Work under this contract was completed on November 13, 1896, the total amount expended being $2,500.

Money statement.

July 1, 1896, balance unexpended	$2,500.00
June 30, 1897, amount expended during fiscal year	2,500.00

3 H.

DEFENSES OF BALTIMORE, MARYLAND.

Officer in charge, Col. Peter C. Hains, Corps of Engineers, with Lieut. Charles W. Kutz, Corps of Engineers, under his immediate orders from October 2, 1896

Fort McHenry, Md.—The fortifications at this place were commenced in 1775, and in 1794 the existing work was built.

Although the old fort has become almost useless as a defensive work against naval attack, the site is still an important one and needed for other purposes. It should be put in good condition.

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During the fiscal year the sea wall on the east side of the reservation was completed, and the grounds back of it graded, seeded, and trees planted. This completes a sea wall so much needed for protection from the action of the sea. Considerable washing back of the old sea wall was filled in and the ground seeded. The grounds were drained and the roads repaired. The construction of the sea wall and the filling in of the low grounds back of it has added materially to the appearance and general usefulness of the post.

Money statements.

PRESERVATION AND REPIR OF FORTIFICATIONS.

July 1, 1896, balance unexpended	$1,711.09
Allotments	10,000.00
	11,711.09
June 30, 1897, amount expended during fiscal year	6,047.18
July 1, 1897, balance unexpended	5,663.91

SEA WALLS AND EMBANKMENTS.

Allotments	$13,750.00
June 30, 1897, amount expended during fiscal year	13,750.00

Abstract of proposals for building a sea wall and making repairs at Fort McHenry, Md., opened at United States Engineer Office, Baltimore, Md., at 12 m., August 7, 1896.

No.	Name and address of bidder.	Riprap, 2,400 cubic yards.		Masonry, 383 cubic yards.		Coping, 655 linear feet.	
		Per cubic yard.	Total.	Per cubic yard.	Total.	Per linear foot.	Total.
1	Owen Patterson, Baltimore, Md	$1.50	$3,600.00	$4.75	$1,819.25	$1.20	$786.00
2	Nardin & Anderson, Baltimore, Md	1.49	3,576.00	6.00	2,298.00	1.50	982.50
3	Albert Weber, Baltimore, Md	2.65	6,360.00	4.30	1,646.90	1.60	1,048.00
4	Patrick Keelty, Baltimore, Md	2.75	6,600.00	3.75	1,436.25	1.70	1,113.50
5	Wm. B. Gray, Baltimore, Md	2.50	6,000.00	5.00	1,915.00	1.50	982.50
6	Smith & Bready, Baltimore, Md	2.25	5,400.00	5.95	2,278.85	1.48	969.40
7	Sanford & Brooks, Baltimore, Md	1.65	3,969.00	4.95	1,895.85	1.65	1,080.75

No.	Name and address of bidder.	Oyster shell filling, 660 cubic yards.		Earth filling, 30,000 cubic yards.		Total.
		Per cubic yard.	Total.	Per cubic yard.	Total.	
1	Owen Patterson, Baltimore, Md	$0.40	$264.00	$0.48	$14,400.00	$20,869.25
2	Nardin & Anderson, Baltimore, Md	.24	158.40	.24	7,200.00	14,214.90
3	Albert Weber, Baltimore, Md	.28½	188.10	.28½	8,550.00	17,793.00
4	Patrick Keelty, Baltimore, Md	.39	257.40	.40	12,000.00	21,407.15
5	Wm. B. Gray, Baltimore, Md	.75	495.00	.55	16,500.00	25,892.50
6	Smith & Bready, Baltimore, Md	.59	389.40	.44	13,200.00	22,237.65
7	Sanford & Brooks, Baltimore, Md	.45	297.00	.45	13,500.00	20,733.60

Contract awarded to Nardin & Anderson.

The following contract was in force during the fiscal year: With Nardin & Anderson for building a sea wall and making repairs, approved August 25, 1896, commenced August 28, 1896, and completed April 23, 1897.

Emplacements for one 12-inch gun and three 8-inch guns.—Twelve and forty-seven one-hundredths acres of land were acquired through condemnation proceedings at a cost of $4,500, which was awarded by the

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jury and confirmed by the United States district court for the district of Maryland. The money has been paid into court.

A project for the construction of a battery consisting of one 12-inch and three 8-inch high-power guns was approved for this site.

The work is being done by contract under the act of June 6, 1896, an allotment having been made for the purpose from the appropriation of March 3, 1897, for gun and mortar batteries. A contract was made, after due advertisement, with Jones, Pollard & Co., of Baltimore, Md. Besides the construction of the battery, the contract includes the construction of a wharf connected with the shore by a causeway and a bulkhead filled with oyster shells. This wharf has been finished.

On March 13, 1897, the contractors commenced the excavation for the battery, and up to the present time have excavated 13,681 cubic yards of material which has been deposited in the parapet; they have also laid 1,682 cubic yards of concrete.

The plant employed on this work consists of a 5-foot cube concrete mixer, bins for stone, sand, and materials composing the concrete, and a narrow gauge railroad connecting the mixer with the wharf head. A wire-cable plant extends from the right to the left of the battery, the two extremities being in towers 60 feet in height, one of which is stationary and the other movable on tracks having a radius of 580 feet. The laying of concrete was commenced May 20. The side walls of the relocator room and the walls and platform of the 12-inch emplacement have been well advanced toward completion.

The erosion of the bank on the north side of the site has been going on for some time and to a very serious extent, so much so that the space required for the battery was becoming cramped. An allotment of $7,000 was made from the appropriations of June 6, 1896, and March 3, 1897, for preservation and repair of fortifications, which was applied to protecting the site. This sum is inadequate to complete the work in a proper manner, but will do much good in protecting the portions most needing attention. About 3,000 cubic yards have been placed up to June 30, 1897. It is desirable that an appropriation should be made for the construction of a sea wall on the exposed sides of the reservation and filling in the low ground behind it. The total cost of the sea wall and fill will be $15,000.

Money statements.

GUN AND MORTAR BATTERIES.

Superintendence.

Allotments	$9,500.00
June 30, 1897, amount expended during fiscal year	3,237.96
July 1, 1897, balance unexpended	6,262.04

Contract.

Allotments	134,300.00
June 30, 1897, amount expended during fiscal year	9,733.50
July 1, 1897, balance unexpended	124,566.50

PRESERVATION AND REPAIR OF FORTIFICATIONS.

Allotments	7,000.00
July 1, 1897, balance unexpended	7,000.00

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Abstracts of proposals for building a gun battery opened at United States Engineer Office, Baltimore, Md., at noon, November 27, 1896.

Materials (all in place).	Approximate quantities.	1. Isaac S. Filbert, Baltimore, Md.		2. Nardin & Anderson, Baltimore, Md.	
		Price.	Total.	Price.	Total.
Ammunition cranes for 12-inch guns	3	$130.00	$390.00	$302.50	$907.50
Ammunition cranes for 8-inch guns	9	125.00	1,125.00	235.00	2,115.00
Bolts and straps for wharf and bulkhead, pounds	3,500	.03½	113.75	.03½	122.50
Broken stone for blind drain....cub. yds.	250	2.05	512.50	2.03	507.50
Broken stone for steps....do....	65	1.95	126.75	2.03	131.95
Brass fittings for doors, manhole covers, and well covers....pounds..	700	.65	455.00	.44	308.00
Boiler for power house	1	247.00	247.00	230.00	230.00
Bricks for paving, gutters, etc...number..	70,000	16.00	1,120.00	18.70	1,309.00
Brick masonry....do....	110,000	16.00	1,760.00	17.60	1,936.00
Concrete masonry No. 1....cubic yards..	17,000	4.69	79,730.00	4.67	79,390.00
Concrete masonry No. 2....do....	1,200	8.89	10,668.00	9.35	11,220.00
Cut stone for steps and curbing....do....	170	39.00	6,630.00	49.00	8,330.00
Culvert pipe, 6-inch....linear feet..	600	.14	84.00	.11	66.00
Culvert pipe, 9-inch....do....	300	.24½	73.50	.19	57.00
Culvert pipe, 12-inch....do....	170	.33	56.10	.28	47.60
Copper wire for electric system..pounds..	300	2.15	645.00	.50	150.00
Copper steam pipe....do....	40	.73	29.20	.60	24.00
Dynamo and engine (10 kilo. Watt. generating set)	1	1,151.00	1,151.00	1,215.50	1,215.50
Common excavation....cubic yards..	13,000	.81	4,030.00	.39	5,070.00
Hardpan excavation....do....	6,000	.41	2,460.00	.65	3,900.00
Rock excavation....do....	1,000	.75	750.00	.85	850.00
Elevator (double) for 12-inch gun	1	975.00	975.00	850.00	850.00
Frames for manholes (wrought iron)..lbs..	1,200	.06	72.00	.06½	78.00
Gratings (cast iron) for traps and sump, pounds	400	.05	20.00	.03½	14.00
Hand force pump	1	15.00	15.00	18.00	18.00
Ladders (wrought iron)....pounds..	2,200	.06	132.00	.05½	121.00
Loam....cubic yards..	2,200	.91	2,002.00	.55	1,210.00
Lumber (white pine for doors, manhole covers, and well covers)....feet B. M..	3,500	.14	490.00	.08	280.00
Lumber (white pine strips for electric connections)....feet B. M..	1,800	.09	162.00	.07	126.00
Lumber (for elevator cover and fence, white pine)....feet B. M..	16,500	.10	1,650.00	.07	1,155.00
Lumber (yellow pine, wharf)....do....	55,000	.02 9/10	1,595.00	.03 3/10	1,815.00
Lamps (16 candlepower, 110 volts, continuous current incandescent)....number..	50	3.71	185.50	3.80	190.00
Logs for bulkheads (white oak)..lin. feet..	2,400	.40	960.00	.30	720.00
Motor for elevator	1	625.00	625.00	590.00	590.00
Oyster shells....cubic yards..	3,000	.50	1,500.00	.55	1,650.00
Posts (cedar) for fence....linear feet..	2,500	.15	375.00	.11	275.00
Piles, bearing and fender for wharf (white oak)....linear feet..	6,000	.25	1,500.00	.33	1,980.00
Porous drain tiles (3-inch)....do....	150	.06	9.00	.03	4.50
Sod....square yards..	6,500	.43	2,795.00	.35	2,275.00
Steam feed pump for boiler	1	91.00	91.00	60.00	60.00
Steel beams....pounds..	100,000	.03½	3,500.00	.03	3,000.00
Steel trolley beams....do....	14,000	.03¾	525.00	.03¾	525.00
Steel plates over magazines....do....	140,000	.03¾	4,550.00	.02¾	3,850.00
Storage battery	1	1,575.00	1,575.00	1,500.00	1,500.00
Switch board	1	209.00	209.00	185.00	185.00
Trolleys....pounds..	600	.35	210.00	.22	132.00
Terra-cotta pipe (assorted sizes, 2 to 4 inches diameter)....linear feet..	100	.06	6.00	.07	7.00
Wrought-iron pipe (assorted sizes up to 3 inches)....pounds..	400	.05	20.00	.05	20.00
Total	.....	.....	137,905.30	.....	140,518.05
Will commence work	.....	Nov. 28, 1896.		At once.	
Will complete work	.....	Dec. 15, 1897.		July, 1898.	

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Abstracts of proposals for building a gun battery opened at United States Engineer Office, Baltimore, Md., at noon, November 27, 1896—Continued.

Materials (all in place).	Approximate quantities.	3. Douglas & Andrews, Baltimore, Md.		4. John J. Shipman, Washington, D. C.	
		Price.	Total.	Price.	Total.
Ammunition cranes for 12-inch guns	3	$108.00	$324.00	$200.00	$600.00
Ammunition cranes for 8-inch guns	9	108.00	972.00	150.00	1,350.00
Bolts and straps for wharf and bulkhead, pounds	3,500	.02¾	96.25	.06	210.00
Broken stone for blind drain....cub. yds..	250	2.00	500.00	2.50	625.00
Broken stone for steps.....do....	65	2.00	130.00	2.50	162.50
Brass fittings for doors, manhole covers, and well covers.....pounds..	700	.50	350.00	.50	350.00
Boiler for power house	1	210.00	210.00	600.00	600.00
Bricks for paving, gutters, etc..number..	70,000	14.96	1,047.20	10.00	700.00
Brick masonry.....do....	110,000	13.14	1,445.40	20.00	2,200.00
Concrete masonry No. 1.....cubic yards..	17,000	4.60	78,200.00	5.15	87,550.00
Concrete masonry No. 2.....do....	1,200	6.90	8,280.00	9.00	10,800.00
Cut stone for steps and curbing.....do....	170	37.00	6,290.00	25.00	4,250.00
Culvert pipe, 6-inch.....linear feet..	600	.27	162.00	.30	180.00
Culvert pipe, 9-inch.....do....	300	.36	108.00	.40	120.00
Culvert pipe, 12-inch.....do....	170	.40	68.00	.60	102.00
Copper wire for electric system..pounds..	300	.85	255.00	.30	90.00
Copper steam pipe.....do....	40	.45	18.00	.30	12.00
Dynamo and engine (10 kilo. Watt. generating set)	1	1,004.00	1,004.00	880.00	880.00
Common excavation.....cubic yards..	13,000	.23	2,990.00	.12	1,560.00
Hardpan excavation.....do....	6,000	.30	1,800.00	.25	1,500.00
Rock excavation.....do....	1,000	.50	500.00	.40	400.00
Elevator (double) for 12-inch gun	1	1,110.00	1,110.00	500.00	500.00
Frames for manholes (wrought iron)..lbs..	1,200	.05	60.00	.09	108.00
Gratings (cast iron) for traps and sump, pounds	400	.03½	13.00	.03	12.00
Hand force pump	1	24.00	24.00	50.00	50.00
Ladders (wrought iron).....pounds..	2,200	.06	132.00	.10	220.00
Loam.....cubic yards..	2,200	.40	880.00	.12	264.00
Lumber (white pine for doors, manhole covers, and well covers).....feet B. M..	3,500	.06½	227.50	.04	140.00
Lumber (white pine strips for electric connections).....feet B. M..	1,800	.04	72.00	.04	72.00
Lumber (for elevator cover and fence, white pine).....feet B. M..	16,500	.04½	742.50	.04	660.00
Lumber (yellow pine, wharf).....do....	55,000	.02 7/10	1,485.00	.05	2,750.00
Lamps (16 candlepower, 110 volts, continuous current incandescent).....number..	50	3.45	172.50	1.10	55.00
Logs for bulkhead (white oak)...lin. feet..	2,400	.26	624.00	.65	1,560.00
Motor for elevator	1	687.00	687.00	330.00	330.00
Oyster shells.....cubic yards..	3,000	.45	1,350.00	.50	1,500.00
Posts (cedar) for fence.....linear feet..	2,500	.10	250.00	.04	100.00
Piles, bearing and fender for wharf (white oak).....linear feet..	6,000	.21	1,260.00	.60	3,600.00
Porous drain tiles (3-inch).....do....	150	.10	15.00	.05	7.50
Sod.....square yards..	6,500	.45	2,925.00	.12½	812.50
Steam feed pump for boiler	1	59.00	59.00	150.00	150.00
Steel beams.....pounds..	100,000	.03	3,000.00	.02	2,000.00
Steel trolley beams.....do....	14,000	.04	560.00	.02	280.00
Steel plates over magazines.....do....	140,000	.03	4,200.00	.02	2,800.00
Storage battery	1	1,375.00	1,375.00	700.00	700.00
Switch board	1	201.00	201.00	158.50	158.50
Trolleys.....pounds..	600	.12	72.00	.25	150.00
Terra-cotta pipe (assorted sizes, 2 to 4 inches diameter).....linear feet..	100	.10	10.00	.05	5.00
Wrought-iron pipe (assorted sizes up to 3 inches).....pounds..	400	.09 4/10	38.40	.05	20.00
Total			126,294.75		133,246.00
Will commence work		On or before Dec. 27, 1896.		On or before the day after contract has been signed.	
Will complete work		Oct. 1, 1897.		Dec. 31, 1897.	

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Abstracts of proposals for building a gun battery opened at United States Engineer Office, Baltimore, Md., at noon, November 27, 1896—Continued.

Materials (all in place).	Approximate quantities.	5. John L. Grim, Philadelphia, Pa.		6. Henry Smith & Sons, Baltimore, Md.	
		Price.	Total.	Price.	Total.
Ammunition cranes for 12-inch gun	3	$360.00	$1,080.00	$95.00	$285.00
Ammunition cranes for 8-inch gun	9	325.00	2,925.00	90.00	810.00
Bolts and straps for wharf and bulkhead, pounds	3,500	.03	105.00	.03	105.00
Broken stone for blind drain....cub. yds.	250	2.64	660.00	1.80	450.00
Broken stone for steps.....do....	65	2.64	171.60	1.80	117.00
Brass fittings for doors, manhole covers, and well covers.....pounds.	700	.50	350.00	.60	420.00
Boiler for power house	1	275.00	275.00	225.00	225.00
Bricks for paving gutters, etc...number.	70,000	16.00	1,120.00	15.50	1,085.00
Brick masonry.....do....	110,000	18.00	1,980.00	17.25	1,897.50
Concrete masonry No. 1.....cubic yards.	17,000	4.85	82,450.00	4.60	78,200.00
Concrete masonry No. 2.....do....	1,200	6.90	8,280.00	8.40	10,080.00
Cut stone for steps and curbing....do....	170	46.00	7,820.00	43.00	7,310.00
Culvert pipe, 6-inch.....linear feet.	600	.35	210.00	.30	180.00
Culvert pipe, 9-inch.....do....	300	.60	180.00	.55	165.00
Culvert pipe, 12-inch.....do....	170	1.25	212.50	.85	144.50
Copper wire for electric system..pounds.	300	1.90	570.00	1.80	540.00
Copper steam pipe.....do....	40	.60	24.00	.50	20.00
Dynamo and engine (10 kilo. Watt. generating set)	1	950.00	950.00	914.00	914.00
Common excavation.....cubic yards.	13,000	.35	4,550.00	.30	3,900.00
Hardpan excavation.....do....	6,000	.45	2,700.00	.60	3,600.00
Rock excavation.....do....	1,000	1.00	1,000.00	.95	950.00
Elevator (double) for 12-inch gun	1	875.00	875.00	1,460.00	1,460.00
Frames for manholes (wrought iron)..lbs.	1,200	.05⅔	69.00	.04½	54.00
Gratings (cast iron) for traps and sump, pounds	400	.02½	11.00	.03½	14.00
Hand force pump	1	20.00	20.00	22.00	22.00
Ladders (wrought iron).....pounds.	2,200	.06	132.00	.06	132.00
Loam.....cubic yards.	2,200	80.00	1,760.00	.75	1,650.00
Lumber (white pine for doors, manhole covers, and well covers).....feet B. M.	3,500	.11	385.00	.10	350.00
Lumber (white pine strips for electric connections).....feet B. M.	1,800	.07	126.00	.08	144.00
Lumber (for elevator cover and fence, white pine).....feet B. M.	16,500	.06	990.00	.09	1,485.00
Lumber (yellow pine, wharf).....do....	55,000	.02$\frac{13}{16}$	1,622.50	.02$\frac{8}{16}$	1,540.00
Lamps (16 candlepower, 110 volts, continuous current incandescent).....number.	50	3.25	162.50	3.25	162.50
Logs for bulkheads (white oak)..lin. feet.	2,400	.25	600.00	.38	912.00
Motor for elevator	1	550.00	550.00	530.00	530.00
Oyster shells.....cubic yards.	3,000	.65	1,950.00	.40	1,200.00
Posts (cedar) for fence.....linear feet.	2,500	.20	500.00	.18	450.00
Piles, bearing and fender for wharf (white oak).....linear feet.	6,000	.27	1,620.00	.25	1,500.00
Porous drain tiles (3-inch).....do....	150	.06	9.00	.08	12.00
Sod.....square yards.	6,500	.45	2,925.00	.40	2,600.00
Steam feed pump for boiler	1	55.00	55.00	60.00	60.00
Steel beams.....pounds.	100,000	.02⅞	2,875.00	.02⅞	2,875.00
Steel trolley beams.....do....	14,000	.04	560.00	.03½	490.00
Steel plates over magazines.....do....	140,000	.03	4,200.00	.03½	4,900.00
Storage battery	1	1,650.00	1,650.00	1,300.00	1,300.00
Switch board	1	190.00	190.00	185.00	185.00
Trolleys.....pounds.	600	.14	84.00	.20	120.00
Terra cotta pipe (assorted sizes, 2 to 4 inches diameter).....linear feet.	100	.18	18.00	.08	8.00
Wrought-iron pipe (assorted sizes up to 3 inches).....pounds.	400	.05	20.00	.10	40.00
Total			141,572.10		135,593.50
Will commence work		Feb. 1, 1897.		Within 20 days after award of contract.	
Will complete work		Dec. 31, 1897.		In 280 working days.	

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Abstracts of proposals for building a gun battery opened at United States Engineer Office, Baltimore, Md., at noon, November 27, 1896—Continued.

Materials (all in place).	Approximate quantities.	7. Owen Patterson, Baltimore, Md.		8. Sanford and Brooks, Baltimore, Md.	
		Price.	Total.	Price.	Total.
Ammunition cranes for 12-inch gun	3	$400.00	$1,200.00	$110.00	$330.00
Ammunition cranes for 8-inch gun	9	350.00	2,250.00	100.00	900.00
Bolts and straps for wharf and bulkhead, pounds	3,500	.05	175.00	.02½	96.25
Broken stone for blind drain....cub. yds.	250	2.00	500.00	1.75	437.50
Broken stone for steps.....do....	65	2.00	130.00	1.75	113.75
Brass fittings for doors, manhole covers, and well covers.....pounds.	700	.75	525.00	.75	525.00
Boiler for power house	1	375.00	375.00	275.00	275.00
Bricks for paving, gutters, etc...number.	70,000	17.00	1,190.00	19.50	1,365.00
Brick masonry.....do....	110,000	16.00	1,760.00	15.75	1,732.50
Concrete masonry No. 1.....cubic yards.	17,000	5.50	93,500.00	4.69	79,730.00
Concrete masonry No. 2.....do....	1,200	9.50	11,400.00	8.50	10,200.00
Cut stone for steps and curbing.....do....	170	55.00	9,350.00	38.00	6,400.00
Culvert pipe, 6-inch.....linear feet.	600	.30	180.00	.15	90.00
Culvert pipe, 9-inch.....do....	300	.60	180.00	.25	75.00
Culvert pipe, 12-inch.....do....	170	.75	127.50	.40	68.00
Copper wire for electric system..pounds.	300	2.50	750.00	.70	210.00
Copper steam pipe.....do....	40	2.50	100.00	.60	24.00
Dynamo and engine (10 kilo. Watt. generating set)	1	1,650.00	1,650.00	1,350.00	1,350.00
Common excavation.....cubic yards.	13,000	.30	3,900.00	.37	4,810.00
Hardpan excavation.....do....	6,000	.30	1,800.00	.37	2,220.00
Rock excavation.....do....	1,000	.50	500.00	.37	370.00
Elevator (double) for 12-inch gun	1	1,000.00	1,000.00	1,050.00	1,050.00
Frames for manholes (wrought iron)..lbs.	1,200	.05	60.00	.04	48.00
Gratings (cast iron) for traps and sump, pounds	400	.04	16.00	.02 3/10	11.60
Hand force pump	1	85.00	85.00	25.00	25.00
Ladders (wrought iron).....pounds.	2,200	.12	264.00	.04	88.00
Loam.....cubic yards.	2,200	1.00	2,200.00	.43	946.00
Lumber (white pine for doors, manhole covers, and well covers).....feet B. M.	3,500	.15	525.00	.06	210.00
Lumber (white pine strips for electric connections).....feet B. M.	1,800	.09	162.00	.06	108.00
Lumber (for elevator cover and fence, white pine).....feet B. M.	16,500	.06	990.00	.04½	742.50
Lumber (yellow pine, wharf).....do....	55,000	.03½	1,925.00	.02¾	1,512.50
Lamps (16 candlepower, 110 volts, continuous current incandescent).....number.	50	9.00	450.00	3.40	17.00
Logs for bulkhead (white oak)...lin. feet.	2,400	.26	624.00	.21	504.00
Motor for elevator	1	600.00	600.00	575.00	575.00
Oyster shells.....cubic yards.	3,000	1.00	3,000.00	.44	1,320.00
Posts (cedar) for fence.....linear feet.	2,500	.15	375.00	.10	250.00
Piles, bearing and fender for wharf (white oak).....linear feet.	6,000	.30	1,800.00	.27	1,320.00
Porous drain tiles (3-inch).....do....	150	.10	15.00	.05	7.50
Sod.....square yards.	6,500	.50	3,250.00	.27	1,755.00
Steam feed pump for boiler	1	85.00	85.00	100.00	100.00
Steel beams.....pounds.	100,000	.05	5,000.00	.02 7/10	2,700.00
Steel trolley beams.....do....	14,000	.12	1,680.00	.02¾	402.50
Steel plates over magazines.....do....	140,000	.05	7,000.00	.02 7/10	3,780.00
Storage battery	1	2,585.00	2,585.00	1,500.00	1,500.00
Switch board	1	275.00	275.00	200.00	200.00
Trolleys.....pounds.	600	.12	72.00	.10	60.00
Terra-cotta pipe (assorted sizes, 2 to 4 inches diameter).....linear feet.	100	.25	25.00	.10	10.00
Wrought-iron pipe (assorted sizes up to 3 inches).....pounds.	400	.15	60.00	.11	44.00
Total			165,665.50		130,668.60
Will commence work		On or after Aug. 4, 1898.		Jan. 1, 1897.	
Will complete work				Dec. 31, 1897.	

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Abstracts of proposals for building a gun battery opened at United States Engineer Office, Baltimore, Md., at noon, November 27, 1896—Continued.

Materials (all in place).	Approximate quantities.	9. Jones, Pollard & Co., Baltimore, Md.		10. Maryland Manufacturing and Construction Co., Baltimore, Md.	
		Price.	Total.	Price.	Total.
Ammunition cranes for 12-inch gun	3	$102.50	$307.50	$275.00	$825.00
Ammunition cranes for 8-inch gun	9	94.80	853.20	250.00	2,250.00
Bolts and straps for wharf and bulkhead, pounds	3,500	.04 9/10	147.00	.05 1/2	192.50
Broken stone for blind drain...cub. yds.	250	2.00	500.00	2.25	562.50
Broken stone for steps...do...	65	2.00	130.00	2.25	146.25
Brass fittings for doors, manhole covers, and well covers...pounds	700	.30	210.00	.65	455.00
Boiler for power house	1	165.00	165.00	285.00	285.00
Bricks for paving, gutters, etc...number	70,000	11.92	834.40	20.00	1,400.00
Brick masonry...do...	110,000	14.51	1,596.10	20.00	2,200.00
Concrete masonry No. 1...cubic yards	17,000	4.35	73,950.00	4.94	83,980.00
Concrete masonry No. 2...do...	1,200	7.15	8,580.00	7.25	8,700.00
Cut stone for steps and curbing...do...	170	36.48	6,201.60	100.00	17,000.00
Culvert pipe, 6-inch...linear feet	600	.09 3/4	58.50	.40	240.00
Culvert pipe, 9-inch...do...	300	.17	51.00	.60	180.00
Culvert pipe, 12-inch...do...	170	.21 9/10	36.72	.80	136.00
Copper wire for electric system...pounds	300	1.30	390.00	1.30	390.00
Copper steam pipe...do...	40	.51 9/10	20.64	.70	28.00
Dynamo and engine (10 kilo. Watt. generating set)	1	822.60	822.60	1,264.00	1,264.00
Common excavation...cubic yards	13,000	.32	4,160.00	.32	4,160.00
Hardpan excavation...do...	6,000	.36	2,160.00	.50	3,000.00
Rock excavation...do...	1,000	.05	50.00	1.30	1,300.00
Elevator (double) for 12-inch gun	1	1,039.50	1,639.50	3,300.00	3,300.00
Frames for manholes (wrought iron)...lbs	1,200	.04 9/10	55.20	.05	60.00
Gratings (cast iron) for traps and sump, pounds	400	.03 9/10	15.60	.05	20.00
Hand force pump	1	19.80	19.80	26.00	26.00
Ladders (wrought iron)...pounds	2,200	.04 9/10	101.20	.05	110.00
Loam...cubic yards	2,200	.32	704.00	.40	880.00
Lumber (white pine for doors, manhole covers, and well covers)...feet B. M.	3,500	.07 1/2	262.50	.13	455.00
Lumber (white pine strips for electric connections)...feet B. M.	1,800	.05 9/10	93.60	.06 1/2	117.00
Lumber (for elevator cover and fence, white pine)...feet B. M.	16,500	.06 1/4	1,072.50	.05	825.00
Lumber (yellow pine, wharf)...do...	55,000	.02 94/100	1,617.00	.04	2,220.00
Lamps (16 candlepower, 110 volts, continuous current incandescent)...number	50	.28	14.00	.28	14.00
Logs for bulkheads (white oak)...lin. feet	2,400	.25 8/10	619.20	.40	960.00
Motor for elevator	1	474.30	474.30	627.00	627.00
Oyster shells...cubic yards	3,000	.54	1,620.00	1.00	3,000.00
Posts (cedar) for fence...linear feet	2,500	.13	325.00	.18	450.00
Piles, bearing and fender for wharf (white oak)...linear feet	6,000	.26 4/10	1,584.00	.40	2,400.00
Porous drain tiles (3-inch)...do...	150	.07 8/10	11.70	.06	9.00
Sod...square yards	6,500	.33	2,145.00	.32	2,080.00
Steam feed pump for boiler	1	44.00	44.00	110.00	110.00
Steel beams...pounds	100,000	.03 3/100	3,090.00	.03 2/10	3,200.00
Steel trolley beams...do...	14,000	.03 11/100	449.40	.04 2/10	588.00
Steel plates over magazines...do...	140,000	.02 99/100	3,710.00	.03 2/10	4,620.00
Storage battery	1	1,481.40	1,481.40	1,690.00	1,690.00
Switch board	1	164.70	164.70	245.00	245.00
Trolleys...pounds	600	.15	90.00	1.00	600.00
Terra-cotta pipe (assorted sizes, 2 to 4 inches diameter)...linear feet	100	.07 8/10	7.80	.15	15.00
Wrought-iron pipe (assorted sizes up to 3 inches)...pounds	400	.07 2/10	28.80	.15	60.00
Total			122,064.46		157,355.25
Will commence work		On or before 10 days after award of contract.		On award of contract.	
Will complete work		Within 9 calendar months.		12 months from that date.	

Contract awarded to Jones, Pollard & Co.

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Contract in force during the fiscal year.

With Jones, Pollard & Co., for building a gun battery, approved January 5, 1897, commenced in December, 1896, and is to be completed September 23, 1897.

Emplacements for eight 12-inch mortars and two 5-inch rapid-fire guns.—This site consists of 28½ acres, which was acquired by condemnation in September, 1896, and paid for with funds from sites for fortifications and seacoast defenses at a cost of $13,500.

A project for the construction of a mortar battery for eight 12-inch rifled mortars was approved June 27, 1896. After due advertisement a contract was made with Sanford and Brooks, of Baltimore, for constructing said battery, and the work of assembling plant and material was commenced in November, 1896. The contract includes the construction of a wharf consisting of a pierhead 30 by 60 feet, situated in 8 feet of water and connected with a shore bulkhead by a causeway 1,000 feet long and 18 feet wide. This wharf has been completed.

Excavation at the site of the mortar battery was begun March 25, 1897, and up to June 30, 1897, 6,591 cubic yards have been removed and placed in the battery slopes. The parapet is to be built of sand, and most of it will come from the bottom of the river brought in scows to the wharf and transferred thence in cars and put in its place of rest in the battery.

Owing to the lack of proper appliances, the excavation for the foundations of the mortar carriages in the east pit proceeded slowly and was still further delayed by a succession of heavy rains causing the banks to cave in and wreck the shoring.

The excavation was carried through a bed of stiff blue clay to an underlying strata of iron ore about 6 inches thick. The top surface of this was irregular, varying from a reference of —5.18 to —7.28. An examination showed that beneath this rock there was a layer of sand about 4 feet thick containing water under pressure. The test hole and all others through which the water made its appearance were closed as thoroughly as possible by Portland cement mortar and a layer of sand with its top at a reference of —4.6 placed over the whole area. The pit was then flooded to settle the sand and afterwards pumped dry and the sand well rammed before the concreting was begun. The laying of concrete commenced May 19, 1897, and 1,403 cubic yards are in place. Thirteen thousand nine hundred and five cubic yards of fill, earth and sand, has been placed in the slopes. Simultaneously with the construction of the foundations for the mortars the work on the magazine walls was begun. The amount of concrete laid in the magazine walls is 943 cubic yards. All the concrete is mixed by hand.

An allotment of $14,737.25 from the appropriation of March 3, 1897, for gun and mortar batteries, was made May 1, 1897, for the construction of two emplacements for 5-inch rapid-fire guns. Advertisment and specifications for this battery were completed June 22, 1897, and proposals for building it are to be opened July 12.

The construction of fortifications for defenses should not be done by contract. A certain amount of publicity is necessary to secure intelligent bids, and this is believed to be detrimental to the Government's interests. We forbid strangers to visit the fortifications. Photographs of them are strictly forbidden except when taken by a duly authorized person, but all the details of the constructions are and must be shown to persons who come to the office in the guise of bidders. It can not fail to be detrimental to have all these details made public.

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The shore line of this site is much exposed, and the banks are being rapidly eroded. Much damage and expense will be saved if a substantial sea wall is constructed on the river and bay sides of the site as soon as funds can be provided. Such a protection wall would not be expensive, while the filling in of the low area between it and the bank would add several acres to an already contracted site. It is recommended that an appropriation of $20,000 be asked to construct such sea wall.

Money statements.

GUN AND MORTAR BATTERIES.

Superintendence.

Allotments	$10,000.00
June 30, 1897, amount expended during fiscal year	3,969.61
July 1, 1897, balance unexpended	6,030.39

Contract.

Allotments	$124,637.25
June 30, 1897, amount expended during fiscal year	12,136.45
July 1, 1897, balance unexpended	112,500.80

Abstracts of proposals for constructing a mortar battery opened at United States engineer office at 12 o'clock, noon, October 26, 1896.

Materials (all in place).	Approximate quantities.	No. 1.—Isaac S. Filbert, Baltimore, Md.		No. 2.—Owen Patterson, Baltimore, Md.		No. 3.—Henry Smith & Sons, Baltimore, Md.	
		Price.	Total.	Price.	Total.	Price.	Total.
Excavation, in place..cubic yards..	6,000	$0.75	$4,500.00	$0.60	$3,600.00	$0.63	$3,780.00
Fill, earth, in place*.....do....	43,000						
Fill, sand, in place* .....do....	43,000	.53	22,790.00	.65	27,950.00	.68	29,240.00
Fill oyster shell, in place ...do....	2,300	.83	1,955.00	.60	1,380.00	.65	1,495.00
Fill, loam .....do....	3,300	2.00	6,600.00	1.00	3,300.00	1.00	3,300.00
Sod.....square yards..	8,260	.30	2,478.00	.50	4,130.00	.45	3,717.00
Concrete No. 1 (body of work), cubic yards	7,000	4.85	33,950.00	6.00	42,000.00	4.90	34,300.00
Concrete No. 2 (foundations), cubic yards	950	6.95	6,602.50	8.00	7,600.00	7.10	6,745.00
Concrete No. 3 (facings), cubic yards	600	9.45	5,670.00	9.00	5,400.00	9.25	5,550.00
Broken stone.....cubic yards..	330	2.37	782.10	2.50	825.00	2.10	693.00
Cut stone.....do....	28	63.00	1,764.00	55.00	1,540.00	44.00	1,232.00
Cut stone (special).....do....	115	91.00	10,465.00	65.00	7,475.00	{ 48.00 / 52.00 }	† 5,520.00
Beams (steel) .....pounds..	61,300	.04½	2,574.60	.06	3,678.00	.03½	2,145.50
Steel trolley beams and trolleys, pounds.....	17,500	.05½	962.50	.12	2,100.00	.07½	1,312.50
Lumber (doors).....feet B. M..	500	.15	75.00	.12	60.00	.15	75.00
White-pine strips for electric connections.....feet B. M..	430	.07	30.10	.08	34.40	.12	51.60
Brass fittings for doors...pounds..	400	.67	268.00	.50	200.00	.70	280.00
Iron fittings for doors .....do....	1,270	.15	190.50	.07	88.90	.15	190.50
Bricks for paving and gutters.....	10,800	19.00	205.20	16.00	172.80	17.50	189.00
Piles (wharf and fender), linear feet	13,640	.31	4,228.40	.26	3,546.40	.27½	3,751.00
Lumber (wharf) .....feet B. M..	147,000	.03 3/10	4,851.00	.02 7/10	4,116.00	.03	4,410.00
Bolts and straps .....pounds..	3,500	.05¾	201.25	.06	210.00	.04½	157.50
Iron pipe .....do....	16,880	.04¾	801.80	.02½	422.00	.02½	422.00
Porous drain tiles.....linear feet..	400	.06¾	27.00	.30	120.00	.10	40.00
Total.....			111,971.90		119,948.50		108,596.60

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Abstracts of proposals for constructing a mortar battery, etc.—Continued.

Materials (all in place).	Approximate quantities.	No. 4.—Nardin & Anderson, McDonogh, Md.		No. 5.—Sanford & Brooks, Baltimore, Md.		No. 6.—J. M. Douglass, Baltimore, Md.	
		Price.	Total.	Price.	Total.	Price.	Total.
Excavation, in place..cubic yards..	6,000	$0.60	$3,600.00	$0.55	$3,300.00	$0.22	$1,320.00
Fill, earth, in place*.....do....	43,000						
Fill, sand, in place*.....do....	43,000	.46	19,780.00	.45	19,350.00	.25	10,750.00
Fill, oyster shell, in place ...do....	2,300	.46	1,058.00	.44	1,012.00	.80	1,840.00
Fill, loam .....do....	3,300	.75	2,475.00	.45	1,485.00	.25	825.00
Sod.....square yards..	8,260	.45	3,717.00	.45	3,717.00	.15	1,239.00
Concrete No. 1 (body of work), cubic yards	7,000	5.50	38,500.00	4.73	33,110.00	3.91	27,370.00
Concrete No. 2 (foundations), cubic yards	950	7.00	6,650.00	6.54	6,213.00	5.83	5,538.50
Concrete No. 3 (facings), cubic yards	600	8.50	5,100.00	8.73	5,238.00	6.32	3,792.00
Broken stone.....cubic yards..	330	3.00	990.00	1.85	610.50	2.78	917.40
Cut stone .....do....	28	50.00	1,400.00	46.62	1,305.36	35.00	980.00
Cut stone (special).....do....	115	50.00	5,750.00	47.75	5,491.25	40.00	4,600.00
Beams (steel).....pounds..	61,300	.04	2,452.00	.02¾	1,685.75	.03½	2,145.50
Steel trolley beams and trolleys, pounds.....	17,500	.05	875.00	.02¾	481.25	.05	875.00
Lumber (doors).....feet B. M..	500	.16	80.00	.06	30.00	.05	25.00
White-pine strips for electric connections .....feet B. M..	430	.16	68.80	.06	25.80	.05	21.50
Brass fittings for doors...pounds..	400	1.50	600.00	1.00	400.00	.30	120.00
Iron fittings for doors .....do....	1,270	.09	114.30	.10	127.00	.08½	107.95
Bricks for paving and gutters....	10,800	22.00	237.60	20.00	216.00	11.00	118.80
Piles (wharf and fender), linear feet	13,640	.27	3,682.80	.23	3,137.20	.26	3,546.40
Lumber (wharf) .....feet B. M..	147,000	.03 3/10	4,851.00	.02 7/10	3,969.00	.02 9/10	4,263.00
Bolts and straps .....pounds..	3,500	.07	245.00	.03	105.00	.03½	122.50
Iron pipe .....do....	16,880	.03	506.40	.02¾	464.20	.05	844.00
Porous drain tiles ....linear feet..	400	.06	24.00	.10	40.00	.30	120.00
Total.....	.....	.....	102,756.90	.....	91,513.31	.....	71,481.55

* Alternative items.

† $5,200 for western granite.

Contract awarded to Sanford & Brooks.

Contract in force during the fiscal year.

With Sanford & Brooks, for building a mortar battery, approved November 12, 1896, commenced in November, 1896, and is to be completed October 1, 1897.

ROCK POINT, MARYLAND.

One hundred acres of land were acquired at this site by condemnation proceedings, at a cost of $27,500. The funds were derived from the appropriation for sites for fortifications and seacoast defenses, act June 6, 1896, and were paid into court.

Under an allotment of $1,400 from the appropriation of March 3, 1897, for preservation and repair of fortifications, a single pile wharf 1,080 feet long, extending to 6 feet of water, has been constructed. The wharf is 6 feet wide and has a pierhead 11 feet by 16 feet.

From the same allotment it is proposed to erect monument stones marking the boundaries of the site.

The site is cared for by a custodian.

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Money statements.

PRESERVATION AND REPAIR OF FORTIFICATIONS.

Allotments	$1,400.00
July 1, 1897, balance unexpended	1,400.00

SITES FOR FORTIFICATIONS AND SEACOAST DEFENSES.

July 1, 1896, balance unexpended	$46,500.00
Allotments	400.00
	46,900.00
June 30, 1897, amount expended during fiscal year	46,802.45
July 1, 1897, balance unexpended	97.55

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3 I.

DEFENSES OF WASHINGTON, DISTRICT OF COLUMBIA.

Officer in charge, Lieut. Col. C. J. Allen, Corps of Engineers; assistants, Lieut. George P. Howell, Corps of Engineers, to July 8, 1896, and Lieut. Jay J. Morrow, Corps of Engineers, since September 7, 1896.

Gun and mortar batteries.—A project for construction of emplacements for two 8-inch guns on disappearing carriages at site B was approved July 10, 1891. This was afterwards modified and designated for 10-inch guns. An allotment of $117,150 from the appropriation of February 24, 1891, for gun and mortar batteries was made for carrying out the project. In September, 1891, active operations commenced. A description of the wharf built and plant purchased for the work was given in the Annual Report for 1893.

In July, 1895, allotments amounting to $20,826 were made for completion of the emplacements and gun platforms; no allotment for the latter had previously been made.

At the close of the fiscal year ending June 30, 1896, the condition of the work was as follows:

The concrete of the parapet and traverses was practically completed, but the superior slope was being covered with granolithic finish made with Portland cement. The concrete of the platforms had been brought up to the reference of the ceiling of the shot chambers; the area about the base ring and traverse rail had been completed. The earthen parapet had been nearly completed and about one-half of the superior slope covered with soil. Excavation for the roadway immediately in rear of the work had been about one-half completed; the curved roadway connecting this with the main road through the reservation had not been commenced.

WORK OF THE PAST FISCAL YEAR.

The concrete work on the gun platforms, traverses, etc., and the construction of the brick rear wall of the shot chamber, including the removal of centers, laying of floors, pointing up, etc., were completed by August 15, 1896. At this date the granolithic surface of the parapet had been completed, excepting over a small area at the north end of the work, and the earthen parapet had been completed and covered with soil. The concreting plant was then taken down and removed to Bat-

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tery C. As soon as practicable the excavation of the roadways in the rear of the work was proceeded with, the sewerage system constructed, and the slopes of the roadways covered with soil. The granolithic surface of the superior slope was completed, the magazine and caponniere walls pointed and whitewashed, the exterior walls pointed and finished, doors made for magazines, galleries, and platforms, iron steps and ladders set, and the ammunition conveyers and hoisting cranes built. The work is completed.

The base rings and traverse rails for the gun carriages were set and the guns were mounted by February, 1897.

On July 2, 1896, an allotment of $50,000 was made for an emplacement for a 10-inch gun on disappearing carriage at site C, and a project for construction of the same was submitted on the 14th and approved on the 21st of that month.

Work under the project commenced on the 1st of August in clearing the site. Surveys for a railroad track to connect the wharf with the site of the emplacement were begun August 11. Steps had previously been taken toward assembling and purchasing material as well as organizing the force. By September 1 the site of the emplacement had been cleared, the railroad had been laid out and the greater part of it graded, the ties had been cut on the reservation and laid on about half of the line, a locomotive had been purchased and delivered, the wharf and inclined plane had been repaired, and erection of the concreting plant was in progress. By the 14th of September the railroad was finished. A water tank, the concrete mixer, trestles, cement shed, and engine house were built at the work, and, to supply water for mixing concrete, a boiler and pump were set on the shore of the creek and connected with the water tank by a pipe line. The laying of concrete was commenced September 25 and continued almost without interruption until November 25, 1896, when the concrete work of the platform, with its granolithic surface, and that of the parapet and traverses (with the exception of the granolithic surface) were completed. The excavation of the roadway in the rear and of the slopes along the lines of fire and between the battery and the river, and the formation of the earthen parapet, were then carried on for part of the winter. The iron steps to platform and observing station were set, doors to platform, magazines, etc., built, and the sewer system of this emplacement completed. The ammunition conveyers were also placed.

This emplacement was practically completed and the gun mounted in May, 1897.

This gun was mounted by artillery troops from Washington Barracks, as were the guns mounted in Battery B, in January and February, 1897, and three 15-inch smoothbores, which were mounted in December, 1896, in the demilune of the old fort.

May 8, 1897, a plan and estimate were submitted, in response to letter of April 3 from the Chief of Engineers, for a second emplacement at Battery C. The project was approved and an allotment of $41,500 made May 17 for this emplacement. Work under this project commenced in June, and by the close of the fiscal year the soil had been stripped from the site, the excavation for the concrete structure was in progress, and repairs to the wharf had begun. Advertisements inviting proposals for delivery of cement, stone, sand, and pebbles were issued in June, to be opened July 6.

It is expected that this emplacement will be completed by November 1 next.

All the work described in the foregoing was done by hired labor.

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Money statement.

July 1, 1896, balance unexpended	$6,765.83
Allotments during the year	91,713.60
	98,479.43
June 30, 1897, amount expended during fiscal year	55,844.77
July 1, 1897, balance unexpended	42,634.66
July 1, 1897, outstanding liabilities	2,051.00
July 1, 1897, balance available	40,583.66

Abstract of proposals for furnishing American natural cement, opened August 12, 1896, by Maj. Charles J. Allen, Corps of Engineers, United States Army.

No.	Name and address of bidder.	Brand.	Price per barrel.	Total (4,000 barrels).
1	Lawrenceville Cement Co., New York, N. Y. (or in bags, per 300 pounds).	Beach's	$0.84½ .67½	$3,380
2	Lawrence Cement Co., New York, N. Y.	Hoffman	.85	3,400
3	New York and Rosendale Cement Co., New York, N. Y.	Brooklyn Bridge	.86½	3,460
4	National Building Supply Co., Baltimore, Md.	Ulster County	.95	3,800
5	J. T. Walker's Sons, Washington, D. C.	Cumberland and Potomac	1.30	5,200
	Or in bags	do	1.05	

Contract in force during year.

Lawrenceville Cement Company, American natural cement, dated August 24, approved September 10, 1896; delivery to be completed October 5, 1896.

Emplacements for three 8-inch guns on disappearing carriages.—A project submitted under date of October 2, 1896, for emplacements for two 8-inch guns on disappearing carriages and also for a wharf, was approved October 17, 1896.

The area of land owned at this point by the United States restricted the location of emplacements.

The work was to be done by contract under the provisions of the act of Congress of June 6, 1896.

Proposals for the work were opened November 23, 1896. Douglas and Andrews, of Baltimore, Md., were the lowest bidders. Upon examining the bid it appeared that emplacements for three guns, as well as the wharf, could be constructed with the contemplated allotment of funds. Contract was accordingly made with Douglas and Andrews December 16. The contract was approved December 31. Work under the contract was to be commenced December 23, 1896, and completed September 1, 1897. Work commenced upon the wharf in January, and upon the excavation in March, 1897. By the close of the fiscal year the wharf had been practically completed, and most of the excavation for the concrete work had been done. The total of excavation, including that for top soil, was 11,623 cubic yards, 5,537 yards of which were duly placed in embankment. An 8-inch pipe sewer 560 feet long, with manhole and silt basin, and one branch sewer 26 feet long, were built, and the drainage system for the lower levels of the emplacement was put in. The laying of concrete in the floors and footings of the magazines and passageways of the three emplacements has begun. A well has been sunk. The contractors have assembled and set up the necessary temporary plant and buildings, including tracks, derricks, engines, and cement sheds.

The following allotment of funds has been made for this work: March 27, 1897, for contract work, wharf and emplacements, act of March 3, 1897, $100,000.

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Money statement.

Amount of allotment	$100,000.00
June 30, 1897, amount expended during fiscal year	13,653.35
July 1, 1897, balance unexpended	86,346.65
July 1, 1897, amount covered by uncompleted contracts	86,346.65

Contingent expenses.—Under this head the inspection and supervision of work under the contract, and the necessary engineering operations connected therewith, have been in progress.

Money statement.

Amount of allotments	$6,125.00
June 30, 1897, amount expended during fiscal year	2,562.12
July 1, 1897, balance unexpended	3,562.88
July 1, 1897, outstanding liabilities	393.00
July 1, 1897, balance available	3,169.88

Abstracts of proposals for constructing wharf and gun emplacements, opened by Maj. Charles J. Allen, Corp of Engineers, United States Army, November 23, 1896.

Material.	Estimated quantity.	G. Snowden Andrews and Henry T. Douglas, Baltimore, Md.		Owen Patterson, Baltimore, Md.		Cranford Paving Company, Washington, D. C.	
		Price.	Amount.	Price.	Amount.	Price.	Amount.
Piles.....linear feet..	27,000	(*)	$3,390.00	$0.16	$4,320.00	$0.18½	$5,040.00
Lumber in wharf.....feet B. M..	168,000	(†)	4,892.00	29.00	4,872.00	44.90	7,543.20
Iron in wharf.....pounds..	22,000	(‡)	686.25	.05	1,100.00	.02½	605.00
Stripping soil.....cubic yards..	2,000	$0.25	500.00	.25	500.00	.18	360.00
Excavation and embankment, cubic yards	10,700	.25	2,675.00	.30	3,210.00	.25	2,675.00
Soil covering.....cubic yards..	2,200	.50	1,100.00	.30	660.00	.25	550.00
Gravel on roadway, etc.....do....	200	1.07	214.00	1.00	200.00	.74	148.00
Natural cement concrete.....do....	7,150	4.43	31,674.50	5.75	41,112.50	5.30	37,895.00
Granolithic concrete.....do....	180	9.00	1,620.00	9.50	1,710.00	9.72	1,749.60
Steel beams.....pounds..	38,000	.03	1,140.00	.05	1,900.00	.02½	855.00
Anchor bolts.....sets..	2	149.00	298.00	340.00	680.00	160.00	320.00
Trolleys.....do....	1	442.41	442.41	330.00	330.00	171.00	171.00
Doors	17	38.00	646.00	45.00	765.00	34.50	586.50
Brick masonry.....cubic yards..	20	9.00	180.00	12.00	240.00	14.00	280.00
Latrines	2	30.00	60.00	75.00	150.00	34.00	70.00
Square drain tile.....linear feet..	5,800	.12	696.00	.15	870.00	.06½	377.00
Round drain tile.....do....	1,000	.09	90.00	.15	150.00	.04½	45.00
Six-inch vitrified pipe.....do....	730	.30	219.00	.25	182.50	.30	219.00
Eight-inch vitrified pipe.....do....	620	1.02	632.40	.35	217.00	.68	421.60
Four-inch cast-iron pipe.....do....	70	.42	29.40	.40	28.00	.36	25.20
Six-inch cast-iron pipe.....do....	270	.55	148.50	.55	148.50	.53	143.10
Basin heads and gratings.pounds..	2,300	.03½	80.50	.05	115.00	.03½	74.75
Gutters.....linear feet..	740	.19	140.60	.20	148.00	.15½	114.70
Gravel backing.....cubic yards..	140	.96	134.40	1.00	140.00	1.00	140.00
Well.....linear feet..	100	(§)	380.00	4.50	450.00	2.55	255.00
Ammunition lifts (1 set—2 double; 2 single)	.....	(‖)	2,335.00	125.00	125.00	1,480.00	1,480.00
Cranes	4	90.00	360.00	150.00	600.00	175.00	700.00
Electric lighting.....plant..	1	3,000.00	3,000.00	3,500.00	3,500.00	6,575.00	6,575.00
Railing and ladders for platforms, sets	2	348.00	696.00	325.00	650.00	303.00	606.00
Iron steps to observing station, sets	1	153.00	153.00	75.00	75.00	176.00	176.00
Ventilating pipes.....linear feet..	170	.30	51.00	.26	44.20	.48	81.60
Speaking tubes.....do....	100	.20	20.00	.30	30.00	.15	15.00
Total	.....	.....	58,683.96	.....	69,222.70	.....	70,297.25
Time of commencement	.....	Dec. 23, 1896.		Jan. 1, 1897.		Dec. 19, 1896.	
Time of completion	.....	Sept. 1, 1897.		Jan. 1, 1898.		June 30, 1897.	

* 25,500 linear feet, at 12 cents; 1,500 linear feet, at 22 cents.
† 166,000 feet, at $29 per M feet B. M.; 2,000, at $39 per M feet B. M.
‡ 20,700 pounds, at 2½ cents; 1,300 pounds, at 9 cents.
§ For well, $3 per linear foot; for pump, $80.
‖ For double lifts, $1,750; for single lifts, $585.

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Abstracts of proposals for constructing wharf and gun emplacements, etc.—Continued.

Material.	Estimated quantity.	John J. Shipman, Washington, D. C.		Sanford & Brooks, Baltimore, Md.		American Artificial Stone Pavement and Construction Company, Philadelphia, Pa.	
		Price.	Amount.	Price.	Amount.	Price.	Amount.
Piles.....linear feet..	27,000	$0.36	$9,720.00	$0.12	$3,240.00	$0.13	$3,510.00
Lumber in wharf.....feet B. M..	168,000	40.00	6,720.00	31.00	5,280.00	30.00	5,040.00
Iron in wharf.....pounds..	22,000	.03	660.00	.03¾	825.00	.03½	770.00
Stripping soil.....cubic yards..	2,000	.20	400.00	.19	380.00	.40	800.00
Excavation and embankment, cubic yards.....	10,700	.20	2,140.00	.55	5,885.00	.45	4,815.00
Soil covering.....cubic yards..	2,200	.25	550.00	.45	990.00	.30	660.00
Gravel on roadway, etc.....do....	200	1.50	300.00	.75	150.00	1.50	300.00
Natural cement concrete....do....	7,150	4.75	33,962.50	5.39	38,538.50	5.75	41,112.50
Granolithic concrete.....do....	180	9.00	1,620.00	9.00	1,620.00	9.55	1,719.00
Steel beams.....pounds..	38,000	.02¾	1,045.00	.03⅛	1,187.50	.02¾	1,045.00
Anchor bolts.....sets..	2	140.00	280.00	300.00	600.00	357.00	714.00
Trolleys .....do....	1	175.00	175.00	600.00	600.00	430.84	430.84
Doors	17	25.00	425.00	50.00	850.00	10.00	170.00
Brick masonry .....cubic yards..	20	12.00	240.00	14.00	280.00	8.50	170.00
Latrines.....	2	16.00	32.00	50.00	100.00	10.00	20.00
Square drain tile.....linear feet..	5,800	.05	290.00	.10	580.00	.12	696.00
Round drain tile .....do....	1,000	.05	50.00	.10	100.00	.12	120.00
Six-inch vitrified pipe.....do....	730	1.00	730.00	.30	219.00	.45	328.50
Eight-inch vitrified pipe....do....	620	1.25	775.00	1.25	775.00	.65	403.00
Four-inch cast-iron pipe....do....	70	.75	52.50	.39	27.30	.75	52.50
Six-inch cast-iron pipe.....do....	270	1.00	270.00	.55	148.50	1.20	324.00
Basin heads and gratings.pounds..	2,300	.03	69.00	.03¾	86.25	.03½	80.50
Gutters.....linear feet..	740	.20	148.00	.15	111.00	.15	111.00
Gravel backing.....cubic yards..	140	1.50	210.00	.75	105.00	1.50	210.00
Well.....linear feet..	100	2.50	250.00	4.50	450.00	4.00	400.00
Ammunition lifts (1 set—2 double; 2 single).....	.....	1,200.00	1,200.00	4,000.00	4,000.00	1,850.00	1,850.00
Cranes	4	100.00	400.00	125.00	500.00	265.00	1,060.00
Electric lighting .....plant..	1	7,000.00	7,000.00	4,000.00	4,000.00	6,700.00	6,700.00
Railing and ladders for platforms, sets	2	250.00	500.00	250.00	500.00	143.00	286.00
Iron steps to observing station sets	1	150.00	150.00	50.00	50.00	265.00	265.00
Ventilating pipes.....linear feet..	170	.40	68.00	.60	102.00	1.00	170.00
Speaking tubes .....do....	100	.20	20.00	.15	15.00	.15	15.00
Total.....	.....	.....	70,452.00	.....	72,295.05	.....	74,347.84
Time of commencement	.....	Jan. 1, 1897.		Jan. 15, 1897.		Jan. 1, 1897.	
Time of completion	.....	Dec. 1, 1897.		Dec. 31, 1897.		Oct. 31, 1897.	

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Abstracts of proposals for constructing wharf and gun emplacements, etc.—Continued.

Material.	Estimated quantity.	John L. Grim, Philadelphia, Pa.		R. H. Hood, Washington, D. C.		Frank Pidgeon, Saugerties, N. Y.	
		Price.	Amount.	Price.	Amount.	Price.	Amount.
Piles.....linear feet..	27,000	$0.15	$4,050.00	$0.25	$6,750.00	$0.20	$5,400.00
Lumber in wharf.....feet B. M..	168,000	29.70	4,989.60	32.00	5,376.00	45.00	7,560.00
Iron in wharf.....pounds..	22,000	.04½	990.00	.04	880.00	.06	1,320.00
Stripping soil.....cubic yards..	2,000	.35	700.00	.35	700.00	.60	1,200.00
Excavation and embankment, cubic yards.....	10,700	.35	3,745.00	.28	2,996.00	.30	3,210.00
Soil covering.....cubic yards..	2,200	.35	770.00	.35	770.00	.60	1,320.00
Gravel on roadway, etc.....do....	200	1.10	220.00	.90	180.00	1.00	200.00
Natural cement concrete....do....	7,150	5.95	42,542.50	5.95	42,542.50	6.20	44,330.00
Granolithic concrete.....do....	180	10.90	1,962.00	10.50	1,890.00	10.00	1,800.00
Steel beams.....pounds..	38,000	.02⅞	1,092.50	.03	1,140.00	.06	2,280.00
Anchor bolts.....sets..	2	375.00	750.00	250.00	500.00	220.00	440.00
Trolleys.....do....	1	475.00	475.00	800.00	800.00	1,200.00	1,200.00
Doors.....	17	25.00	425.00	35.00	595.00	15.00	255.00
Brick masonry.....cubic yards..	20	17.00	340.00	10.00	200.00	25.00	500.00
Latrines.....	2	25.00	50.00	75.00	150.00	100.00	200.00
Square drain tile.....linear feet..	5,800	.28	1,624.00	.15	870.00	.35	2,030.00
Round drain tile.....do....	1,000	.25	250.00	.12	120.00	.30	300.00
Six-inch vitrified pipe.....do....	730	.35	255.50	.40	292.00	.50	365.00
Eight-inch vitrified pipe....do....	620	.45	279.00	1.50	930.00	1.50	930.00
Four-inch cast-iron pipe....do....	70	.50	35.00	.70	49.00	1.35	94.50
Six-inch cast-iron pipe.....do....	270	.65	175.50	.80	216.00	1.35	364.50
Basin heads and gratings.pounds..	2,300	.05	115.00	.03	69.00	.10	230.00
Gutters.....linear feet..	740	.45	333.00	.20	148.00	.65	481.00
Gravel backing.....cubic yards..	140	1.50	210.00	.90	126.00	1.00	140.00
Well.....linear feet..	100	3.00	300.00	2.25	225.00	.....	500.00
Ammunition lifts (1 set—2 double; 2 single).....	.....	2,000.00	2,000.00	1,800.00	1,800.00	2,500.00	2,500.00
Cranes.....	4	285.00	1,140.00	500.00	2,000.00	800.00	3,200.00
Electric lighting.....plant..	1	6,600.00	6,600.00	4,250.00	4,250.00	2,000.00	2,000.00
Railing and ladders for platforms, sets.....	2	160.00	320.00	225.00	450.00	200.00	400.00
Iron steps to observing station, sets.....	1	360.00	360.00	100.00	100.00	250.00	250.00
Ventilating pipes.....linear feet..	170	.75	127.50	.75	127.50	.60	102.00
Speaking tubes.....do....	100	.25	25.00	.25	25.00	.25	25.00
Total.....	.....	.....	77,250.50	.....	77,267.00	.....	85,127.00
Time of commencement.....	.....	In 60 days from award of contract.		20 days after execution of contract.		Feb. 15, 1897.	
Time of completion.....	.....	Within 1 year from award of contract.		150 working days after money becomes available.		Aug. 25, 1897.	

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Abstracts of proposals for constructing wharf and gun emplacements, etc.—Continued.

Material.	Estimated quantity.	B. F. Sweeten & Son, Camden, N. J.		John Jacoby, Wilmington, Del.	
		Price.	Amount.	Price.	Amount.
Piles.....linear feet..	27,000	$0.20	$5,400.00	$0.20	$5,400.00
Lumber in wharf.....feet B. M..	168,000	49.50	8,316.00	32.00	5,376.00
Iron in wharf.....pounds..	22,000	.05	1,100.00	.03	660.00
Stripping soil.....cubic yards..	2,000	.20	400.00	.25	500.00
Excavation and embankment.....do....	10,700	.30	3,210.00	.35	3,745.00
Soil covering.....do....	2,200	.40	880.00	.35	770.00
Gravel on roadway, etc.....do....	200	1.00	200.00	1.25	250.00
Natural cement concrete.....do....	7,150	7.50	53,625.00	9.00	64,350.00
Granolithic concrete.....do....	180	20.00	3,600.00	15.00	2,700.00
Steel beams.....pounds..	38,000	.03⅘	1,368.00	.02½	950.00
Anchor bolts.....sets..	2	203.15	406.30	150.00	300.00
Trolleys.....do....	1	211.20	211.20	185.00	185.00
Doors	17	33.00	561.00	50.00	850.00
Brick masonry.....cubic yards..	20	15.00	300.00	20.00	400.00
Latrines	2	25.00	50.00	50.00	100.00
Square drain tile.....linear feet..	5,800	.10	580.00	20.00	1,160.00
Round drain tile.....do....	1,000	.09	90.00	.18	180.00
Six-inch vitrified pipe.....do....	730	.25	182.50	.40	292.00
Eight-inch vitrified pipe.....do....	620	.35	217.00	.60	372.00
Four-inch cast-iron pipe.....do....	70	.75	52.50	.50	35.00
Six-inch cast-iron pipe.....do....	270	1.00	270.00	.70	189.00
Basin heads and gratings.....pounds..	2,300	.05	115.00	.03¾	86.25
Gutters.....linear feet..	740	.20	148.00	.20	148.00
Gravel backing.....cubic yards..	140	1.00	140.00	1.00	140.00
Well.....linear feet..	100	3.50	350.00	4.00	400.00
Ammunition lifts (1 set—2 double; 2 single)...	.....	1,680.00	1,680.00	425.00	425.00
Cranes	4	225.00	900.00	180.00	720.00
Electric lighting.....plant..	1	7,593.75	7,593.75	6,000.00	6,000.00
Railing and ladders for platforms.....sets..	2	350.00	700.00	350.00	700.00
Iron steps to observing station.....sets..	1	200.00	200.00	190.00	190.00
Ventilating pipes.....linear feet..	170	1.00	170.00	.45	76.50
Speaking tubes.....do....	100	.15	15.00	.18	18.00
Total.....	.....	.....	93,031.25	.....	97,667.75
Time of commencement.....	.....	Dec. 1, 1896.		Dec. 20, 1896.	
Time of completion.....	.....	July 1, 1897.		Oct. 1, 1897.	

Contract in force.

Douglas & Andrews, Baltimore, Md., construction of wharf and emplacements, dated December 16, approved December 31, 1896; date of commencement, December 23, 1896; date of completion, September 1, 1897.

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3 J.

DEFENSES OF HAMPTON ROADS, VIRGINIA.

Officer in charge, Capt. T. L. Casey, Corps of Engineers, with Lieut C. W. Kutz, Corps of Engineers, under his immediate orders until October 1, 1896; Division Engineer, Col. P. C. Hains, Corps of Engineers.

Emplacements and platforms for two 10-inch guns.—A project for the construction of emplacements for two 10-inch guns was approved June 11, 1891, and an allotment of $158,848 made for their construction. Since that date $3,774 has been provided in addition, by transfer from other works, and another allotment of $1,300 made for the work, increasing the total amount provided for the construction of the emplacements to $163,922. Of this amount, $3,157.48 was expended in building a railroad back of the fort to connect with the Chesapeake and Ohio track,

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and can not properly be considered as a part of the cost of constructing the emplacements.

At the close of the fiscal year 1896 these emplacements were completed excepting the following minor details: Cement washing vertical walls, whitewashing magazines, erecting ammunition trolleys, and filling gap at south end with sand and covering slope with soil and sod.

Operations during the fiscal year have been confined to the completion of the unfinished work.

An allotment of $10,292 was made July 26, 1895, for the platforms for these emplacements, which were to be constructed for 10-inch Buffington-Crozier disappearing carriages. These platforms were completed at the beginning of the fiscal year with the exception of sodding a small surface in the rear of the shell recesses and the erection of cranes for raising ammunition.

Three ammunition cranes have been provided for each platform, at an aggregate cost of $630. The surface back of the shell recesses has been covered with 40 cubic yards of soil and clay and 140 square yards of sod. Of the disbursements made during the fiscal year, $150.62 was expended on the construction of the railroad connecting with the Chesapeake and Ohio tracks.

The carriages and guns were received early in the fiscal year and the work of mounting them upon their platforms was completed in December, 1896. This work was done by the garrison at Fortress Monroe. On March 22, 1897, under authority of the Secretary of War, these emplacements were turned over to the commanding officer of Fortress Monroe, Va., for the use of the troops of his command.

The concrete, sand, etc., required in constructing this two-gun battery, the cost of each item in place, and the total cost of construction may be stated as follows, and includes all items of expense except office expenses. The sand, soil, clay, and sod were available on the reservation.

Emplacements:	
18,268 cubic yards of Rosendale concrete, in place, at $6.823	$124,656.89
20,872 cubic yards of sand, in place, at 40 cents	8,548.80
1,587 cubic yards of soil for slopes, in place, at 75 cents	1,190.25
1,587 cubic yards of clay for slopes, in place, at 75 cents	1,190.25
6,051 square yards of sod for slopes, in place, at 35 cents	2,117.85
Trolleys for ammunition service	366.67
Doors, complete, and stone facings for doorways	6,689.51
Total, for emplacements	[1]144,560.22
Platforms:	
115 cubic yards of Portland concrete, in place, at $9.50	1,092.50
549 cubic yards of Rosendale concrete, in place, at $7.75	4,256.75
4,700 square feet of granolithic finish, at .133 cents	626.25
1,577 cubic yards of sand for fill, in place, at 45 cents	709.65
Stone for doorways and steps	643.74
88 steel bolts, fitted with vibration-proof nuts	586.24
Iron work for platforms and setting base rings and index circles	768.71
764 linear feet steel angles, I-beams, and plates	339.05
20 cubic yards of soil, in place, at 40 cents	8.00
20 cubic yards of clay, in place, at 40 cents	8.00
140 square yards of sod, in place, at 36 cents	50.40
6 ammunition cranes, in place	730.48
Total, for platforms	9,819.77
Total cost of battery	154,379.99

[1] $10,490.94 is included in the cost of above items for removing old concrete platforms, magazines, etc., when this work was commenced.

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Money statements.

EMPLACEMENTS.

July 1, 1896, balance unexpended	$4,196.96
June 30, 1897, amount allotted during fiscal year	1,300.00
	5,496.96
June 30, 1897, amount expended during fiscal year	3,882.79
July 1, 1897, balance unexpended	1,614.17
July 1, 1897, outstanding liabilities	918.74
July 1, 1897, balance available	695.43

PLATFORMS.

July 1, 1896, balance unexpended	$1,825.45
June 30, 1897, amount expended during the fiscal year	1,627.04
July 1, 1897, balance unexpended	198.41

Allotments.

EMPLACEMENTS.

Act February 24, 1891, allotment of June 11, 1891	$158,848.00
Act July 23, 1892, allotment of July 26, 1895	3,774.00
Act March 3, 1897, allotment of May 20, 1897	1,300.00
Total for emplacements	163,922.00

PLATFORMS.

Act March 2, 1895, allotment of July 26, 1895	$10,292.00
Total for platforms	10,292.00

Emplacement and platform for one 10-inch gun.—The sum of $64,000 was allotted for the construction of this emplacement, and $5,020 for the platform. Nine thousand seven hundred and seventy-four dollars of the former has since been transferred to other works, making the total amount provided for the emplacement $54,226. Of this latter amount $625.43 has been expended for materials needed in the construction of the railroad connecting with the Chesapeake and Ohio tracks.

The emplacement lacked but little work to complete it at the close of the fiscal year 1896, and the work during the present fiscal year was carried on with this end in view, and consisted of cement-washing the vertical walls, white-washing magazines, painting doors of same, and erecting trolleys to convey ammunition.

The platform for this emplacement had been completed during the fiscal year 1896, with the exception of the cranes for hoisting ammunition, and these are now in position. The carriage and gun have been received and mounted and turned over to the commanding officer of Fort Monroe for the use of troops of his command.

The emplacement and platform were constructed by hired labor with material purchased under contract as far as practicable. The cost of the emplacement and platform is as follows:

Emplacement:	
8,313 cubic yards of Rosendale concrete, in place, at $4.9855	$41,444.62
9,818 cubic yards of sand, in place, at 40 cents	3,927.20
1,185 cubic yards of clay and soil for slopes, in place, at 60 cents	711.00
2,265 square yards of sod, in place, at 35 cents	792.75
Doors complete and stone facing for doorways	1,253.57
Trolley for ammunition service	183.33
Total cost of emplacement	48,312.47

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Platform:	
61 cubic yards of Portland concrete, in place, at $9.50	$579.50
253 cubic yards of Rosendale concrete, in place, at $7.75	1,960.75
2,350 square feet of granolithic finish, at .133 cents	312.55
391 cubic yards of sand for fill, in place, at 40 cents	156.40
Stone for doorways and steps	321.87
15 cubic yards of soil and clay, in place, at 40 cents	6.00
60 square yards of sod, in place, at 36 cents	21.60
44 steel bolts, fitted with vibration-proof nuts	298.05
Ironwork for platform and setting base ring and index circles	424.49
382 linear feet of steel I-beams, angles, and plates	174.45
3 ammunition cranes in place	375.63
Total for platform	4,631.29
Total for 1 gun battery	52,943.76

The above includes all expenditures made in connection with the work, except office expenses. The sand was available on the Fort Monroe reservation, as was the clay, soil, and sod.

Money statements.

EMPLACEMENT.

July 1, 1896, balance unexpended	$1,024.48
June 30, 1897, amount expended during fiscal year	1,011.00
July 1, 1897, balance unexpended	13.48
July 1, 1897, outstanding liabilities	13.48

PLATFORM.

July 1, 1896, balance unexpended	$770.27
June 30, 1897, amount expended during fiscal year	577.02
July 1, 1897, bala ce unexpended	193.25
July 1, 1897, outstanding liabilities	169.85
July 1, 1897, balance available	23.40

Allotments.

EMPLACEMENT.

Act July 23, 1892, allotment of November 8, 1892	$64,000.00
Transferred to other works	9,774.00
Amount available for emplacement	54,226.00

PLATFORM.

Act March 2, 1895, allotment of July 26, 1895	$5,020.00
Total for emplacement and platform	59,246.00

Single 10-inch gun emplacement.—With funds appropriated by the act of March 3, 1897, it is proposed to construct an emplacement for a 10-inch gun mounted on an experimental disappearing carriage, model 1894. Plans and estimates are now in course of preparation, in order that funds may be provided for constructing the emplacement.

Mortar battery.—Two allotments of $100,000 each have been made for the construction of this battery, which is to contain sixteen 12-inch mortars, with the four pits placed in a single line along the sand dunes.

The work which had been done at the close of the fiscal year 1896 was of a preliminary nature, such as extending the railroad to the site of the battery, repairing the old roadbed, removing and reerecting plant used in the construction of the emplacements, clearing the site of underbrush, and excavating about 6,000 cubic yards of sand for the foundation of the battery.

During the month of August, 1896, the first concrete was placed, and

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this work has been continued during all favorable weather. At the close of the fiscal year all concrete in the pits, wing walls, and main work was in position excepting that which is to extend over the sand slope to protect it from the blast of discharge. This work can not be done until after the sand covering has been placed and settled.

In constructing the battery, the amount of concrete mixed, placed, and rammed in the different parts of the battery, and its cost, including superintendence and repairs to plant, is as follows:

	Cubic yards.	Per cubic yard.
In main work	16,294	$4.92
In wing-walls	1,585	5.07
In platforms:		
Portland	877	7.90
Rosendale	528	5.10
In passageways between pits	703	5.16
In passageways and floors of main work	377	5.22
In tower on battery	41	5.50

Except in the platforms of Pits Nos. 2, 3, and 4, Rosendale cement of the Beach brand was used exclusively. A layer of stone was placed in the bottom of the platform of Pit No. 2, and upon this concrete was thoroughly rammed. The platforms of Pits Nos. 3 and 4 are wholly of Portland cement concrete, while those of Pit No. 1 are in considerable part of cut stone and were constructed for the model 1894 carriage. The remaining platforms are designed for the 1896 model. About one-half of the concrete in the platforms was mixed by hand, increasing the cost somewhat. The concrete portion of the platforms was completed December 1, 1896.

The work of placing the sand covering over the main work was commenced in June, 1897, and, together with that removed and used in the slopes when the foundation was excavated, 20,200 cubic yards of sand had been conveyed and placed at the close of the fiscal year, at an average cost of 26 cents per cubic yard in position.

For the purpose of conveying and depositing the sand on the battery an inclined track has been laid, extending from the south end of the battery behind the numerous sand dunes. The sand is loaded into dump cars and then pushed up on the main work by a locomotive, and deposited. The fill was commenced at the south end of the battery, and the track is extended over the main work as the fill proceeds.

The material for the battery, with the exception of 4,115.65 and 5,831.32 cubic yards of 1 and 2 inch broken stone, respectively, was purchased by invitation of proposals in the usual manner. Award in each instance was made to the lowest bidder. The material was delivered in vessels alongside the Engineer wharf, and was unloaded by the United States and hauled over the railroad to the site of the battery.

The amount and nature of materials purchased and delivered in this manner during the fiscal year is as follows:

23,377.63 barrels of Rosendale cement.
1,198 barrels of Portland cement.
7,115.65 cubic yards of 1-inch broken stone.
10,831.32 cubic yards of 2-inch broken stone.
208,879 feet B. M., of yellow-pine lumber.
64 pieces of dimension stone, 18 inches by 3 feet by 6 feet 3 inches.
207 linear feet of steel channels.
5,126 linear feet steel I-beams.
397.5 linear feet Z-angles.
534 steel bolts and washers.
208 tons of coal.

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In addition to the above, the following material was purchased and delivered in the same manner for use in constructing the railroad connecting with the Chesapeake and Ohio tracks:

70 3/11 tons 45-pound steel rails.
2,492 railroad ties, 7 by 8 by 7.
5,500 pounds railroad spikes.
340 angle joints, with bolts.
2 frogs.
2 split switches.
2 switch stands.
40,190 feet B. M., of lumber.

The necessary labor for constructing this railroad was paid for from funds provided for this battery, and the material from funds for other works. The total cost of the railroad was $10,570.22, of which $5,449.94 was for labor and $5,120.28 for material.

The total amount expended to the close of the fiscal year 1897 on account of this battery is $132,661.88.

Money statement.

June 30, 1896, balance unexpended	$88,413.09
June 30, 1897, amount allotted during fiscal year	100,000.00
	188,413.09
June 30, 1897, amount expended during fiscal year	121,074.97
July 1, 1897, balance unexpended	67,338.12
July 1, 1897, outstanding liabilities	4,094.30
July 1, 1897, balance available	63,243.82

Allotments.

Act February 24, 1891, allotment of March 18, 1896	$5,118.50
Act March 2, 1895, allotment of March 11, 1895	94,881.50
Act June 6, 1896, allotment of July 1, 1896	100,000.00
Total	200,000.00

List of all contracts in force.

Name and address of contractor.	Date of approval of contract.	Date of beginning deliveries of materials.	Date of expiration of contract.
J. H. Middendorf, Richmond, Va.	June 18, 1896	July 31, 1896	Aug. 11, 1896
C. H. Bull, Norfolk, Va.	June 24, 1896	July 18, 1896	Sept. 5, 1896
Lawrenceville Cement Co., New York, N. Y.	June 30, 1896	July 1, 1896	May 24, 1897
McClenahan & Bro. Granite Co., Port Deposit, Md.	Aug. 5, 1896	July 28, 1896	Nov. 30, 1896

Range-finder tower. An allotment of $1,800 was made from the appropriation for gun and mortar batteries, act of March 2, 1895, for the construction of a tower and shelter for a Lewis Range Finder, in accordance with the plans and estimate for the same, submitted under date of September 30, 1896.

The site for this range-finder tower had previously been selected by a board of officers convened for that purpose.

Bids for constructing the tower were invited by public notice of fifteen days, and were opened December 30, 1896, the lowest bidder being Holtzclaw Bros., of Hampton, Va., at $1,179, with whom a contract was entered into for the work.

The tower was completed and turned over to the commanding officer of the post in April, 1896. The tower was erected in two mutually

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independent sections, the inner section being of brick, 10 feet in diameter at the base and 5 feet at the top, 2 feet in diameter on the inside throughout, and 41 feet 5 inches in height above the level of the terreplein. The top of the brick tower is capped with a block of concrete 5 feet in diameter and 1 foot thick. Six sections of wrought-iron pipe, filled with concrete, were placed in the concrete cap to carry the base ring of the range finder. These pipes project 31 inches above the top surface of the cap. The outer section consists of a timber trestle anchored to four concrete piers with 1¼-inch anchor bolts and independently supporting the shelter for the range finder. This house is 14 by 14 by 8 feet inside dimensions. The roof is pitched on four sides and covered with tin. A window 14 by 2½ feet, without sash or glass, was provided for the side of house facing the channel approaches, also one each on the north and south side extending halfway across the house. Within the wooden tower there is a stairway, with double railing. The timber part of the tower received two coats of paint of a color which it is hoped will render it as inconspicuous as possible.

The framework of the trestle was not inclosed when first constructed, but on account of the vibration of the brick tower from wind pressure it became necessary to do this eventually, corrugated iron being nailed to the framework of the outer tower. This cost $270, including two coats of paint.

Although this tower is well constructed, it can not be said to be completely successful for the purposes intended; for, owing to its great height and necessarily limited weight and spread of base, it vibrates perceptibly on moderate shock at the top. If such disturbances are avoided, however, it will probably serve for accurate observations with the range finder.

The total cost of the tower was $1,741.14.

Money statement.

June 30, 1897, amount allotted during fiscal year	$1,800.00
June 30, 1897, amount expended during fiscal year	1,741.14
July 1, 1897, balance unexpended	58.86

Allotment.

Act March 2, 1895, allotment of December 8, 1896	$1,800.00

Abstract of bids for constructing a tower and wooden building received in response to public notice dated December 16, 1896, and under specifications of the same date, and opened by Capt. Thomas L. Casey, Corps of Engineers, December 30, 1896.

No.	Name and address of bidder.	Amount bid.	Remarks.
1	A. D. Wallace, Hampton, Va	$1,294	
2	Holtsclaw Bros., Hampton, Va*	1,179	Lowest bid.
3	J. H. Brinson, Hampton, Va	1,340	
4	J. C. Bulifant, Hampton, Va	2,240	

* Contract entered into January 21, 1897.

Amount available for work under contract, $1,800.

List of all contracts in force.

Name and address of contractor.	Date of approval of contract.	Date of beginning work.	Date of expiration of contract.
Holtsclaw Bros., Hampton, Va	Feb. 9, 1897	Jan. 21, 1897	Mar. 22, 1897

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Breakwater and beach protection.—No funds were available for this work during the fiscal year. Both the breakwater between the north end of the Hygeia Hotel and the Engineer Wharf and the jetties extending from the shore are in good condition, except that in one part the upper surface of the concrete sea wall has been warped off by expansion caused by the sun's heat. The usefulness of the jetties in protecting the beach from erosion becomes more apparent each year, as the beach still continues to make out toward the outer end of the jetties.

Water supply.—No work has been done and no funds have been expended during the fiscal year. The recommendations in the last annual report, given on pages 497 and 498, part 1 of Annual Report of the Chief of Engineers, 1896, are renewed.

Money statement.

July 1, 1896, balance unexpended	$5,908.95
July 1, 1897, balance unexpended	5,908.95

Appropriation.

Act February 24, 1891	$6,000.00

SEWERAGE SYSTEM, FORT MONROE, VIRGINIA.

The work on the sewerage system has been confined to the completion of the flushing system and the connection of the three sets of quarters on the street bank of the Hygeia Hotel. The cost of the former was $1,856.04 and of the latter $583.80.

Under authority of the Secretary of War, the post quartermaster at Fort Monroe, Va., assumed charge of the operation and maintenance of the system on September 1, 1896.

A full report of the construction of the system was submitted November 9, 1896, and printed in House Document No. 42, Fifty-fourth Congress, second session; it is hereto appended.

The expenditures during the fiscal year have been for outstanding liabilities at the close of the fiscal year 1896 and for percentages retained from the contractor for the work.

The system cost, including outstanding liabilities given below, $49,527.31.

Money statement.

July 1, 1896, balance unexpended	$13,246.81
June 30, 1897, amount expended during fiscal year	12,441.12
July 1, 1897, balance unexpended	805.69
July 1, 1897, outstanding liabilities	333.00
July 1, 1897, balance available	472.69

REPORT OF RECEIPTS AND EXPENDITURES OF CONSTRUCTION AND MAINTENANCE OF SEWERAGE SYSTEM AT FORT MONROE, VIRGINIA.

[Printed in House Doc. No. 42, Fifty-fourth Congress, second session.]

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., November 9, 1896.

GENERAL: In accordance with first indorsement, dated October 14, 1896, on file No. 7285–134, I have the honor to submit the following report of the construction of the sewerage system at Fort Monroe, Va.:

Congress, by act approved August 1, 1894, appropriated the sum of

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$37,500 for one-half the cost of constructing a sewerage system for all buildings at Fort Monroe, Va., with the proviso that the owners of the hotels and other nonmilitary buildings on the reservation should bear the other half of the expense, and authorized the Secretary of War to apportion among, assess, and collect from the said owners their moiety of the estimated cost.

Some of the owners of nonmilitary buildings considered that the amount of expenditure contemplated by Congress was greatly in excess of the necessary cost of a sewer system sufficient for the requirements of the military and nonmilitary residents at Fort Monroe, and it was then decided to employ a civilian expert to design and submit an estimate of the cost of a suitable system. Mr. Rudolph Hering, C. E., S. E., of New York, who was called upon for this information, submitted a plan for a system estimated to cost $41,320, but suggested that it might be well to invite bids for extra concrete, timber, and brick work, in case additional quantities should be required. The amount of this estimate was therefore increased to $45,000, to cover any work as above mentioned, and to provide for cost of inspection, superintendence, fee of expert, and incidental expenses. By order of the Secretary of War the moiety was assessed on the nonmilitary owners and occupants of buildings on this basis of cost, they being notified by personal service, in compliance with the provisions of the act, on November 12 and 13, 1894, of the amounts severally assessed against them for the construction of the sewerage system, and at the same time directed to deposit the amount indicated in the notice with the National Metropolitan Bank, Washington, D. C., on or before December 14, 1894, the said bank having been designated by the Secretary of War as the depository for the funds collected from the nonmilitary owners.

Before the system had been completed, it became evident that its cost would exceed $45,000, and Congress, by joint resolution approved April 24, 1896, amended the proviso in the act of August 1, 1894, that the owners of nonmilitary buildings should bear one-half of the expense of its construction, and authorized the expenditure of $5,000 from the appropriation of August 1, 1894, in addition to the amount set aside by the Secretary of War as the Government's quota of the expense, making the total amount provided $50,000, including the amount ($22,500) collected from the nonmilitary owners of buildings.

The following table shows the per cent of the moiety assessed upon each of the hotels and other owners of nonmilitary buildings at Fort Monroe, Va., together with the amount of each assessment and the date of payment:

Name.	Per cent of moiety.	Amount of assessment.	Date of deposit in National Metropolitan Bank.
Hygeia Hotel	44.7	$10,057.50	Dec. 14, 1894
Chamberlin Hotel	45.5	10,237.50	Jan. 18, 1895
Sherwood Hotel	5.5	1,237.50	Dec. 15, 1894
Chesapeake and Ohio Rwy	1.1	247.50	Dec. 13, 1894
Adams Express Co	.4	90.00	Nov. 24, 1894
Wm. H. Kimberly	.7	157.50	Dec. 13, 1894
Wm. Baulch	.6	135.00	Dec. 8, 1894
J. A. Watkins	.9	202.50	Dec. 11, 1894
U. S. light-house	.3	67.50	July 1, 1896
Capt. R. D. Evans	.2	45.00	Nov. 21, 1894
Rev. Mercer	.1	22.50	Dec. 3, 1894
Total	.....	22,500.00	

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Specifications for the construction of the system in accordance with the plans of Mr. Hering were prepared and proposals invited by advertisement, dated November 24, 1894. The proposals received were opened December 29, 1894, and were as follows:

No.	Name and address of bidder.	Price for entire work.
1	Thos. L. Rosser, jr., Minneapolis, Minn	$34,482.50
2	Hankins, Mosby & Kelly, Richmond, Va	41,204.90
3	John Jacobi, Wilmington, Del	42,597.00
4	Crook, Horner & Co., Baltimore, Md	45,798.52
5	Joseph Jenkins, Wilmington, Del	47,244.50
6	Isaac G. Brown, New York City	51,598.50
7	Corcoran & Connell, Pittsburg, Pa	53,185.70
8	Owen Pattison, Baltimore, Md	55,577.50
9	T. Bresnan & Co., Baltimore, Md	62,715.25
10	H. Davin, Roanoke, Va	65,051.40

NOTE.—The different parts of the system were bid for separately. All the sewer pipe by the linear foot; the flush tanks and manholes at a specified price each; the sewage reservoir and the pumping station complete; the extra brick masonry and concrete by the cubic yard.

The contract for constructing the sewer system was awarded to the lowest bidder, Thomas L. Rosser, jr., of Minneapolis, Minn., on January 25, 1895, the delay in awarding it being due to the failure of the Hampton Roads Hotel Company to deposit the amount of their assessment until January 18, 1895. The contract was signed on January 29, 1895, and was approved by the Chief of Engineers, United States Army, February 1, 1895, the work to be commenced within forty-five days after notification of award of contract, or March 12, 1895, and to be completed on or before the end of the calendar year 1895. The date of completion was extended on December 26, 1895, to March 1, 1896; on February 29, 1896, to April 15, 1896, and on April 25 to June 15, 1896.

As it was subsequently ascertained from borings made after the specifications had been prepared that the character of the bottom at the site proposed for the reservoir, which was supposed to be sand, was too soft to support its weight, black quicksand mixed with mud and water having been shown by the boring tube at a depth of 14 feet below mean low tide, it became necessary to change the manner of building the reservoir, which, according to the specifications, was to be brick, cylindrical in form, 50 feet interior diameter, built upon an iron shoe or curb, and sunk as excavation proceeded; the bottom of the reservoir to be of concrete, conical in shape, 17 feet at the center and 14 feet at the circumference below mean low tide.

The change decided upon after careful study of the existing conditions was the excavation of a circular trench of sufficient width to allow the wall of the reservoir to be constructed between two polygonal rings of sheet piling, well shored and braced, driven from the level of ground water. In place of the iron shoe, the footing of the wall was to be of concrete, the space between the wall and the outer sheeting to be filled in as the wall progressively increased in height, and the interior to be excavated as soon as the wall should reach permanent ground water level.

This method of constructing the reservoir increased the cost of the work, and a supplemental contract was entered into with the contractor on April 20, 1895, covering the changes made, the price agreed upon being $2,000. The supplemental contract was approved May 13, 1895.

Actual work on the construction of the system was commenced by the contractor on April 22, 1895, and it was completed and in use by

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all the inhabitants of the reservation early in June, 1896, except the three sets of quarters on the glacis beyond the Hygeia Hotel, which had been connected directly with the outfall sewer in accordance with the adopted plans. When the pumps were operated, the pressure in the outfall sewer unsealed the traps in these quarters, permitting the escape of foul gas therein. The quarters had to be disconnected and the laterals stopped with brick and mortar. Subsequently authority was obtained to connect them with the sewage tank by a lateral extending from the manhole back of the Hygeia Hotel to the most remote of the three sets of quarters, at an estimated cost of $895. The necessary materials were purchased and the work done by hired labor during the month of August, 1896, at a cost of $583.80, including cost of superintendence.

The plant constructed for operating the system consists of an engine and boiler house, coal shed, and sewage reservoir, all situated on the west side of the main road in the rear of the engineer storehouses.

The engine and boiler house is of brick, 38 feet in length, 31½ feet in width, and 19 feet in height above the surface, and contains three rooms, viz, engine and pump room, boiler room, and a small office or workroom. The foundations are of rubble masonry 2 feet thick, and the walls are of hard-burned brick 12 inches in thickness. The floors of the pump and boiler rooms are of concrete and the office floor is laid with 2-inch tongued and grooved dressed pine. Duplicate engines and pumps are located in the pump and engine room, being sunk in a pit 6 feet below the surface of the floor, in order to decrease the amount of lift.

The engines are of the vertical type, 45 horsepower each, and are separately connected with two 8-inch centrifugal pumps, each capable of raising and discharging through the force main about 1,200 gallons per minute. Two vertical boilers of 30 horsepower each have been placed in the boiler room and the necessary pipe connections made. They have been connected with the engines in such a manner as to enable each separately or both together to supply steam to either engine. The boilers have not steaming capacity to do this separately, however, and in actual practice the service of both are necessary for the operation of either of the pumps. The coal shed is 32 feet long, 24 feet wide, and 10 feet to the plate. It is constructed of wood covered with corrugated iron and has a capacity of 100 tons.

The reservoir was built in the manner indicated above, and is provided with a roof of wood, covered with tin, and supported by the walls and four iron columns erected within the tank. In order to relieve, in a measure, the pressure against the wall, the outer polygon of sheet piling was allowed to remain in position, its purchase from the contractor for this purpose being duly authorized by the Department.

Two main sewers of 8-inch and 12-inch vitrified pipe discharge the sewage from the hotels and other buildings on the reservation into the reservoir. The 8-inch main, with its laterals, drains all the quarters on the Mill Creek road, including the Sherwood Hotel and the buildings to the west of the plant. The 12-inch main extends from the reservoir to the main road, where it connects with 8 and 10 inch pipe mains, the former, with its laterals, draining all the buildings within the enciente and the latter the buildings on the glacis, the Hygeia and Chamberlin hotels, and stores on the main street. In laying the main to the buildings inside the fort, cast-iron pipe of the same size as the vitrified pipe was used in crossing the moat. This was laid in concrete and the joints calked with lead.

For the disposal of the sewage a force main of 10-inch cast-iron pipe was laid to a point in the rear of Engineer Quarters No. 8, where it dis-

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charges into the outfall sewer of 14-inch vitrified pipe extending to the manhole near the shore end of Jetty No. 1. From this manhole 14-inch wrought-iron pipe runs out into the bay to a depth of between 18 and 19 feet at low water. The wrought-iron pipe rests on creosoted cross-ties, securely bolted to two rows of creosoted piles, driven 6 feet apart, 16 inches in the clear between the rows. Riprap filling has been placed around and for a height of 2 feet on top of the pipe to protect it against the action of the waves. In order to preserve it in salt water the wrought-iron outfall pipe was given two coats of metallic paint, at a cost of $88.61. Manholes and flush tanks were constructed at suitable points.

The following statement shows the number of linear feet of each size of pipe laid, the number of manholes and flush tanks built, and the cost of the construction of the system under the contracts with Thomas L. Rosser, jr.:

Amount of work.	Price.	Total.
12,101.32 linear feet 6-inch vitrified sewer	$0.37	$4,477.49
9,351.87 linear feet 8-inch vitrified sewer	.46	4,301.87
251 linear feet 10-inch vitrified sewer	.83	208.33
260.65 linear feet 12-inch vitrified sewer	.95	247.62
1,795 linear feet 14-inch vitrified outfall sewer	.80	1,436.00
108 linear feet sewer across ditch	4.40	475.20
540.50 linear feet force main	1.00	540.50
380 linear feet wrought-iron outfall sewer	9.75	3,705.00
13 flush tanks	35.00	780.00
47 manholes	60.00	1,645.00
285.02 cubic yards extra concrete	7.00	1,995.13
27.384 cubic yards extra brick masonry	8.50	232.78
Constructing sewerage reservoir	10,345.00	10,345.00
Extra work on same under supplemental contract	2,000.00	2,000.00
Constructing pumping station and coal shed, and furnishing and installing boilers, engines, and pumps	7,530.00	7,530.00
Total cost of system under contracts		39,919.92

A suitable flushing arrangement for the system has been provided, at a cost of $1,856.04. The material for this was purchased under public notice and the necessary labor hired to do the work. A tank for the purpose of storing water obtained from driven wells was placed upon a frame near the pumping station and a small pump purchased and installed in the pump house to force the water into the tank. Iron pipe of suitable size connects this tank with the 14 flush tanks.

The following gives the items of cost of the sewerage system:

For work under contracts	* $39,919.92
Purchase of outer ring of sheet piling and extra granite sills	601.18
Constructing flushing system	1,856.04
Building lateral to three sets of quarters on glacis beyond Hygeia Hotel	583.80
Cost of inspection of work under contract	3,069.24
Traveling expenses of inspectors, etc	102.02
Changing laterals to quarters on Mill Creek road	154.96
Painting wrought-iron outfall sewer	88.61
Fee of expert and traveling expenses	1,027.35
Mileage paid to officers	66.12
Salaries of assistant engineer, clerk, and copyist	1,395.00
Printing, advertising, and stationery	161.81
Telegraphing	6.88
Labor and material in laying out work	158.48
Total cost of sewerage system	49,191.41

* Three thousand nine hundred and ninety-three dollars and sixty-four cents of this amount has not yet been paid the contractor, as the specifications provided that one-half of the percentages retained from payments made during the progress of the work should be held for a period of one year from the date of completion of the contract, and expenditures made during that time for repairs to the system, on account of faulty construction, be deducted therefrom, and the balance remaining, or all, in case no deductions were made, to be paid at the expiration of that time.

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The expenditures to date amount to $45,197.77, of which $21,388.82 has been paid from the fund collected from the owners of the nonmilitary buildings on the reservation, and $23,808.95 from the appropriation provided in the act of August 1, 1894, leaving balances at this date for the former of $1,111.18, and for the latter $3,691.05. When the amount retained from the contractor is expended, no funds will remain to the credit of the nonmilitary fund, and should there be no additional expense a balance of $808.59 will remain from the amount appropriated for the work by the Government.

Respectfully submitted.

THOS. L. CASEY,
Captain, Corps of Engineers.

Brig. Gen. WILLIAM P. CRAIGHILL,
Chief of Engineers, U. S. Army, Washington, D. C.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS, U. S. A.,
November 20, 1896.

Respectfully submitted to the Secretary of War, in compliance with instructions of October 13, 1896.

W. P. CRAIGHILL,
Brig. Gen., Chief of Engineers.

ASSISTANT QUARTERMASTER'S OFFICE,
Fort Monroe, Va., August 3, 1896.

SIR: I have the honor respectfully to report the operations of the quartermaster's department at this station in carrying out the provisions of the act of Congress approved August 1, 1894, in the collection and disbursement of the funds therein authorized and for the purposes stated, as regards sewer maintenance, wharf repair and maintenance, and for the repair and operation of roads, pavement, streets, lights, and general police, during the fiscal year ending June 30, 1896.

This work has been done under the rules and regulations as published in circular of November 5, 1894, War Department, Adjutant-General's Office.

This report, as far as the sewer system is concerned, only embraces the items of maintenance since construction, its construction having devolved upon the Engineer Department of the Army.

For the objects authorized in the act above quoted the act of Congress approved March 2, 1895 (act making appropriations for fortifications and other works), makes the following appropriations:

Repair and maintenance of wharf.

For labor and material to redeck one-third of main pier	$2,773.00
Labor and material to redeck apron of pier	482.00
Sixty oak fender piles	1,500.00
Labor and material to renew oak binders to pier	325.00
Wharfinger's salary	1,020.00
Laborer cleaning wharf	480.00
In all	6,580.00

One-half said sum to be supplied by the United States, $3,290.

For the objects above stated the "water navigation companies using the wharf" were assessed and paid the following sums under the rules quoted above, viz:

Baltimore Steam Packet Company	$969.17
Old Dominion Steamship Company	923.45
New York, Philadelphia and Norfolk Railroad	618.29
Norfolk and Washington Steamboat Company	603.39
Virginia Navigation Company	175.70
Total	3,290.00

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Out of these sums the following expenses were incurred and paid, viz:

For fender piles and oak binders	$764.12
For renewing and repairing decking	2,202.00
Salary of wharfinger	900.00
Salary of laborer	420.00
Total	4,286.12

One-half of the above amount, viz, $2,143.06, was paid by the Government and the other half by the "water navigation companies using the wharf." Account current with vouchers covering above is herewith.

The act quoted also makes the following appropriations, viz, "repair and maintenance of roads, pavements, streets, lights, and general police:"

20,000 bushels of oyster shells, at 5 cents per bushel	$1,000.00
30,000 paving brick, at $10 per M	300.00
150 square yards granolithic pavement, at $2.25 per yard	337.00
One horse and cart for police of street	250.00
One laborer to drive same	360.00
Eight street lamps	196.00
Oil and supplies for same	52.00
One laborer to care for same	240.00
In all	2,735.00

For one-half this sum to be supplied by the United States, $1,367.50.

Maintenance of sewer system.

One superintendent	$1,200.00
Two enginemen, at $900	1,800.00
Two firemen, at $600	1,200.00
Three laborers, at $500	1,500.00
One horse and cart	650.00
Coal	600.00
Waste, oil, and pump repairs	250.00
Sewer pipe, cement, etc	300.00
Total	7,500.00

For one-half of said sum to be supplied by the United States, $3,750.

To carry out the objects above listed, the owners of "Hotels and other nonmilitary buildings on the reservation, individuals and corporations doing business thereon," were assessed and paid the following sums, viz:

Hygeia Hotel	$1,077.95
Chamberlin Hotel	1,095.90
Sherwood House	144.07
Chesapeake and Ohio Railroad Company	109.64
Hampton and Old Point Railroad Company	950.11
Adams Express Company	8.62
William H. Kimberly, merchant	16.67
William Baulch, merchant	14.86
James A. Watkins, merchant	21.43
Capt. R. D. Evans, United States Navy, residence	5.14
Catholic Church, church and school	3.36
Total	3,447.75

Out of these sums the following expenses were incurred and paid, viz:

For oyster shells for road	$614.64
For paving brick	336.50
For granolithic sidewalks	322.50
One horse and cart	175.00
For street lamps and oil	117.42
Fuel for sewer engines	177.00
Sewer supplies	157.68
Driver of police cart, salary one year	360.00
Lamplighter caring for street lamps, one year	240.00
Two enginemen, salary for April, May, and June	$330.00
Two firemen, salary for April, May, and June	220.00
Laborer for May and June	83.32
Total expended	3,134.06

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Of this total, one-half, viz, $1,567.03, was paid by the United States out of the moneys appropriated, and the other half, $1,567.03, was paid by the "owners of hotels and other nonmilitary buildings, by individuals, and corporations doing business on the reservation," under the law.

In addition to the sum of $3,290 collected from the water navigation companies and reported herein for wharf repair, there was charged and collected from the Hampton and Old Point Railroad Company using the wharf the sum of $162.75 for the same purpose, making the total collected for "wharf repair" for the fiscal year $3,452.75. This collection was made from the Hampton and Old Point Railroad Company under the orders of the Secretary of War, as conveyed in the letter from the Quartermaster-General's Office of October 30, 1894 (No. 5840), and was made under the terms of the revocable license granted it by the Secretary directing that this road pay such sum as the Secretary might direct for the repair and maintenance of the wharf, and for the privilege of extending its tracks upon the wharf for traffic purposes.

Unexpended balances remaining on hand at the close of the fiscal year are available and are being used to continue the work and objects for which they were appropriated and collected.

The new sewer system came into fair operation the latter part of April last, and is now in daily successful use. The expense of its maintenance is below the amount originally estimated.

The improvements in wharf, streets, lights, pavements, and sanitary police are in successful progress and are being economically and carefully pushed to the finish projected. The advantages and comforts to the health and prosperity of this community by the operations of this act are very great, and the good effects are shared with equal satisfaction by the military and nonmilitary interests of the Fort Monroe Reservation.

Very respectfully,

JOHN W. PULLMAN,
Captain and Assistant Quartermaster, U. S. A.

QUARTERMASTER-GENERAL, U. S. A.,
Washington, D. C.

[First indorsement.]

WAR DEPARTMENT, QUARTERMASTER-GENERAL'S OFFICE,
Washington, D. C., August 17, 1896.

Respectfully forwarded to the honorable the Secretary of War.

GEO. A. WEEKS,
Assistant Quartermaster-General, United States Army.

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3 K.

DEFENSES OF COAST OF NORTH CAROLINA.

Officers in charge, Lieut. Col. David P. Heap, Corps of Engineers, to March 12, 1897, and Capt. William E. Craighill, Corps of Engineers, after that date; assistant, Lieut. Edgar Jadwin, Corps of Engineers; Division Engineer, Col. Peter C. Hains, Corps of Engineers.

Emplacements for three 8-inch guns.—A battery for 8-inch rifles upon disappearing carriages has been in progress under contract with John L. Grim, of Philadelphia.

Contract was entered into for three emplacements on December 9, 1896. The date set for completion is December 1, 1897.

March 1, 1897, was set as the date for the plant and material to be ready for concreting to begin. It was not ready until May 8, when the first concrete was laid in the battery. Work since this date has been practically confined to one emplacement, the masonry of which is, at the end of the year, about three-fourths completed. The magazines of this emplacement are well covered with concrete and sand and the platform is in such a condition that the emplacement might be made ready to receive its armament by August 1. But little has been done on the second emplacement, and nothing on the third.

The total amount of concrete masonry built is 2,966.66 cubic yards, and of sand embankment in the parapet is 2,286.5 cubic yards. The amounts estimated of these materials to complete the three emplacements are respectively 14,000 cubic yards and 15,000 cubic yards.

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Requisition has been made on the Ordnance Department for guns and carriages, and notice has been received that the guns will be shipped in the near future, and the carriages probably not before September 1.

This battery has been under the local charge of Lieut. Edgar Jadwin, Corps of Engineers, whose report is submitted herewith.

Money statement.

SUPERINTENDENCE.

September 8, 1896, allotted	$175.00
November 24, 1896, allotted	7,825.00
	8,000.00
June 30, 1897, amount expended during fiscal year	4,012.43
July 1, 1897, balance unexpended	3,987.57
July 1, 1897, outstanding liabilities	703.19
July 1, 1897, balance available	3,284.38

CONTRACT WORK.

March 27, 1897, allotted		$119,900.00
June 30, 1897, amount expended during fiscal year		10,206.55
July 1, 1897, balance unexpended		109,693.45
July 1, 1897, outstanding liabilities	$7,273.04	
July 1, 1897, amount covered by uncompleted contracts	102,420.41	
		109,693.45

Abstract of proposals for constructing gun emplacements, opened at 2 o'clock p. m., November 21, 1896, by Lieut. Col. D. P. Heap, Corps of Engineers.

Items.	1—J. J. Shipman, Washington, D.C.		2—J. L. Grim, Philadelphia, Pa.		3—Louis H. Skinner, Wilmington, N. C.	
	Price.	Amount.	Price.	Amount.	Price.	Amount.
Labor:						
3,500 cubic yards excavation, embankment, and grading, cubic yard	$0.50	$1,750.00	$0.25	$875.00	$0.60	$2,100.00
7,000 cubic yards fill, in excess of excavation, cubic yard	.60	4,200.00	.27	1,890.00	.60	4,200.00
7,500 cubic yards concrete, mixing and placing, cubic yard	5.00	37,500.00	1.65	12,375.00	11.00	82,500.00
1,000 tons large broken stone, placing, do	7.00	3,241.00	1.45	671.35	6.00	2,778.00
Material:						
14,000 barrels American Rosendale cement, barrel	2.00	28,000.00	1.20	16,800.00	1.25	*17,500.00
2,000 barrels American Portland cement, barrel	5.00	10,000.00	2.65	5,300.00	3.10	*6,200.00
7,500 cubic yards small broken stone, cubic yard	3.50	26,250.00	2.97	22,275.00	3.78	*28,350.00
1,000 tons large broken stone, ton	6.50	6,500.00	2.50	2,500.00	4.00	*4,000.00
150 cubic yards fine crushed granite, cubic yard	6.50	975.00	5.40	810.00	5.00	*750.00
4 iron ladders, each	10.00	40.00	25.00	100.00	12.50	*50.00
200 feet iron railing, foot	.20	40.00	.24	48.00	1.50	*300.00
12 wooden doors, single leaf, each	12.00	144.00	29.00	348.00	15.00	*180.00
12 wooden doors, double leaf, do	22.00	264.00	60.00	720.00	30.00	*360.00
160 feet 4-inch cast-iron drainpipe, foot	1.50	240.00	.60	96.00	.55	*88.00
20 iron perforated covers for drains, each	5.00	100.00	.50	10.00	1.00	*20.00
400 feet 6-inch porous tile drainpipe, foot	.25	100.00	.15	60.00	.30	*120.00
300 feet brass tube, 1 inch diameter, ⅛ inch thick, foot	.25	75.00	.40	120.00	.75	*225.00
40 feet hard-rubber or fiber tubes, 1 inch inside diameter, foot	.15	6.00	1.20	48.00	.30	*12.00
2 flights cast-iron steps, each	100.00	200.00	110.00	220.00	300.00	*600.00
25,000 pounds steel I-beams and channel irons, etc, pound	.05	1,250.00	.03	750.00	.04½	*1,125.00
15,000 hard-burnt red brick, thousand	22.00	330.00	13.00	195.00	10.00	*150.00
8,402 pounds steel anchor bolts, nuts, and washers, pound	.10	840.20	.05	420.10	.05	*420.10
Total		122,045.20		66,631.45		152,528.10

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Abstract of proposals for constructing gun emplacements, etc.—Continued.

Items.	4—J. Friday, Pittsburg, Pa.		5—Stewart Contracting Co., Columbia, S. C.		6—A. B. Cook, Petersburg, Va.	
	Price.	Amount.	Price	Amount.	Price.	Amount.
Labor:						
3,500 cubic yards excavation, embankment, and grading.....cubic yard..	$0.25	$875.00	$0.30	$1,050.00	$0.27	$945.00
7,000 cubic yards fill, in excess of excavation.....cubic yard..	.25	1,750.00	.30	2,100.00	.27	1,890.00
7,500 cubic yards concrete, mixing and placing.....cubic yard..	2.60	19,500.00	4.92	36,900.00	8.10	60,750.00
1,000 tons large broken stone, placing.do....	2.00	926.00	1.33	615.79	8.10	3,750.30
Material:						
14,000 barrels American Rosendale cement, barrel.....	1.30	18,200.00	1.10	15,400.00	1.20	16,800.00
2,000 barrels American Portland cement, barrel.....	2.50	5,000.00	2.25	4,500.00	2.40	4,800.00
7,500 cubic yards small broken stone, cubic yard.....	2.60	19,500.00	3.90	29,250.00	2.80	21,000.00
1,000 tons large broken stone.....ton..	2.80	2,800.00	2.75	2,750.00	2.00	2,000.00
150 cubic yards fine crushed granite, cubic yard.....	2.60	390.00	6.90	1,035.00	3.20	480.00
4 iron ladders.....each..	15.00	60.00	12.00	48.00	18.00	72.00
200 feet iron railing.....foot..	2.00	400.00	1.00	200.00	.15	30.00
12 wooden doors, single leaf.....each..	100.00	1,200.00	75.00	900.00	18.00	216.00
12 wooden doors, double leaf.....do....	175.00	2,100.00	150.00	1,800.00	31.00	372.00
160 feet 4-inch cast-iron drainpipe.....foot..	.50	80.00	.50	80.00	.25	40.00
20 iron perforated covers for drains..each..	7.50	150.00	2.00	40.00	.50	10.00
400 feet 6-inch porous tile drainpipe...foot..	.35	140.00	.50	200.00	.20	80.00
300 feet brass tube, 1 inch diameter, ⅛ inch thick.....foot..	.50	150.00	.60	180.00	.40	120.00
40 feet hard-rubber or fiber tubes, 1 inch inside diameter.....foot..	.30	12.00	1.00	40.00	.80	32.00
2 flights cast-iron steps.....each..	200.00	400.00	125.00	250.00	100.00	200.00
25,000 pounds steel I-beams and channel irons, etc.....pound..	.03½	875.00	.03½	875.00	.04	1,000.00
15,000 hard-burnt red brick.....thousand..	15.00	225.00	15.00	225.00	15.00	225.00
8,402 pounds steel anchor bolts, nuts, and washers.....pound..	.06	504.12	.07	588.14	.04	336.08
Total.....	.....	75,237.12	.....	99,026.93	.....	115,148.38

* The cost for these items included in the price for labor.

Contract awarded to No. 2, J. L. Grim.

List of contracts in force June 30, 1897.

John L. Grim, contractor; contract dated December 9, 1896, approved January 19, 1897; work to be commenced March 1, 1897, and to be completed December 1, 1897.

EXTRACT FROM REPORT OF FIRST LIEUT. EDGAR JADWIN, CORPS OF ENGINEERS.

The sum of $175 was allotted September 8, 1896, from gun and mortar batteries, act of June 6, 1896, for the necessary surveys and for preparations of plans for two 8-inch gun emplacements.

The ground was surveyed and plans were prepared. Proposals were opened, after thirty days' public notice, November 21, 1896. The award was made to the lowest bidder, Mr. John L. Grim, Girard Building, Philadelphia, Pa.

* * * * * * *

The contractor included the cost of his plant in the figures given above. A large part of this plant was to become the property of the United States at the termination of the contract. Later the construction of the third emplacement was also awarded to Mr. Grim at the same price as the other two, except labor for mixing and placing concrete, for which 82½ cents is to be paid per cubic yard. This difference was made because he is to be allowed to use the same plant for which he will be paid in supplying the quantities originally estimated for two emplacements.

The contract with Mr. Grim was dated December 9, 1896, and was approved January 19, 1897. Work on plant was commenced December 11, 1896. Excavation for the battery was commenced March 3, 1897.

The plant not being ready to lay concrete as required by March 1, 1897, action was taken under paragraph 78 of the specifications, and the contractor was assisted, princi-

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pally by the purchase of material to complete the plant sufficiently to permit the laying of concrete to commence May 8, 1897.

The plant is estimated to have cost $16,894, of which $10,450 was for material and $6,444 for labor. The engines, boilers, and many of the larger pieces were second-hand, and are included in the above at their estimated value.

The plant consists of one office; temporary quarters for a part of the contractor's men; a wharf head 17 feet by 58 feet, partially rebuilt, with a connecting bridge to the shore, 20 feet by 86 feet, partially rebuilt; a 3-foot-gauge railroad about three-fourths of a mile long, 30-pound rails, 5-inch by 8-inch and 6-inch by 8-inch by 5-foot ties, 2-foot centers, maximum grade 1 in 40; one Baldwin locomotive; two 8 by 12 cylinders; one single cylinder 7 by 10 fore-and-aft engine to run mixers, supplied by two vertical upright boilers—combined heating surface, 222 square feet; combined grate surface, 7½ square feet—which also run a pump, 5-inch stroke, 4¼-inch diameter steam, 5¼-inch diameter water-grate surface; one hoisting engine, double drum, 7 by 10 cylinders, for hauling hopper cars from tunnel to top of mixer, grade 1 on 3½; three hoisting engines, double drum, 6 by 10, operating derricks for excavating and placing concrete; one hoisting engine, single drum, 7 by 10, operating derrick at wharf; two cement sheds, 30 by 105 and 20 by 50, combined capacity by crowding 5,000 barrels; one stone bin, capacity 1,000 cubic yards; one sand bin, capacity 250 cubic yards; tunnel 108 by 6 feet wide by 5 feet high (too low); one mixer platform, with two 4-foot Duane cubical mixers, with friction clutches and hollow axles; one guy derrick, 90-foot mast, 76-foot boom; one guy derrick, 70-foot mast, 74-foot boom; one guy derrick, 50-foot mast, 55-foot boom; one stiff-leg derrick on wharf, 18 foot mast, 25-foot boom; one stiff-leg derrick at battery, 21-foot mast, 25-foot boom, for unloading large stone; twelve side dump cars, 2¼-inch axles; eight flat cars, partly 3-inch axles; one water tank, 3,500 gallons; one blacksmith shop; one storeroom; several small structures for engine houses, stables, oils, etc.

Minor plant.—Very little mixing has been done with the second mixer, the second large derrick having just been erected, and excavation and framing not being far enough advanced to keep more than one mixer busy. Otherwise the entire plant has been kept more or less steadily employed since concrete laying was commenced.

The railroad, when it reaches the battery, runs parallel to its rear, and 40 feet distant.

This is convenient for delivering large stone, coal, lumber, etc., opposite place when they are to be used, but a distance of 60 feet would have been better. Sidings have been constructed at both ends of line to facilitate running of these trains when handling cement, large stone, and lumber, so as to have one loading, one unloading, and one en route.

The main road has a temporary prolongation beyond the sand bin of about 1,000 feet to the sand hills, where supply of sand is procured.

The sand and small broken stone are dumped from the track into the bin, whose floor is 12 feet below. The doors in the bottom of the bin are operated by vertical levers with a 2 to 1 purchase.

Hopper cars run under the bin in a tunnel having one track, which branches at the mouth of the tunnel into two tracks running respectively to the hoppers over the mixers.

Several cast-iron parts of the mixers broke soon after being put in use, and were replaced by wrought-iron parts. Excavating is done principally by shoveling into one-half-yard coal buckets, which are swung to the dump by derrick. The material excavated is sand. Trouble was experienced at first in erecting outside forms, but it was overcome by excavating at the bottom to 2 feet outside the line of the battery, and thence upward on as steep a slope as the sand would hold while forms were being placed, about 3 on 2.

A trench 1 foot wide by 1 foot deep was dug just outside the line, a sill laid, and 4 by 6 posts erected on it about 4 feet apart. One-inch rough boards were used on surfaces, afterwards to be covered with sand. Two-inch dressed boards with two-thirds-inch grooves and loose tongues were used elsewhere. The mixers are 60 feet from rear of work. The 1-yard charge is dumped into a skip resting on flat cars; car is pulled within reach of derrick ordinarily by mule; the skip lifted bodily and dumped where concrete is to be used. Difficulty was experienced at first in serving the large derrick with its heavy weight, particularly against an unfavorable wind. The trouble was aggravated by the room required for the boom and tag lines, and the men handling them. This was effectually overcome by giving the top of the derrick an 18-inch lean toward the bisectrix of the average angle of swing, and erecting a snubbing post on this line somewhat nearer the mast than the usual projected length of boom. A tag line was fastened to the hook of the running block and run to the snubbing post. As soon as the strain of the load is on the falls, the engineer runs the engine rapidly for several turns, hoisting on both boom and hoisting lines. The tag line being held fast, its outer end with block and load rapidly swing inward toward the battery as they go up. The momentum carries the skip in until it

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reaches its dumping place when it is snubbed. Most of the water for concrete and for boilers has been obtained from surface wells. The supply seems capable of indefinite multiplication, but the water causes considerable scaling and foaming in the boilers. A well has been sunk about 70 feet, from which a better supply is hoped for.

The usual size of gangs is as follows:

Landing and hauling material, wharf to site: one master laborer, 2 engineers, 1 fireman, 14 laborers.

Excavating and hauling sand to bin: One master laborer, 1 engineer, 1 fireman, 7 laborers.

Excavating: One master laborer, 1 engineer, 1 fireman, 9 laborers.

Framing: One master carpenter, 14 carpenters.

Mixing and placing: Three engineers, 3 firemen, 1 master laborer, 2 masons, 28 laborers.

General: One superintendent, 1 overseer, 1 clerk, 1 timekeeper, 1 rigger, 1 rigger's helper, 1 blacksmith, 1 blacksmith's helper, 1 watchman, 1 chief machinist and engineer.

Ramming: One master laborer, 15 laborers.

The sizes of these gangs and the amounts of work done daily by them have varied greatly. A record of the time of the contractor's men and amount of material used has, however, been kept, and the above operations are estimated to have cost him as follows:

Landing and hauling material, wharf to site, per car, 76 cents. A dump car holds 2½ cubic yards broken stone. A flat car holds 18 barrels cement.

Excavating and hauling sand to bin, per cubic yard, 10 cents.

Excavation, including embankment and grading, per cubic yard, 45 cents. This item is high because much of the sand is handled twice, and the cost of handling that part which has already been handled only once is at present charged to that part which has been finally placed.

Framing, per cubic yard concrete, 80½ cents, of which 42 cents was material and 38½ cents labor.

Mixing and placing concrete and large stone, per cubic yard, 56 cents.

Ramming concrete, per cubic yard, 23 cents.

The totals of work to July 1, 1897, are:

	Cubic yards.
Excavation	2286.5
Concrete in place	2721.5
Large stone in place	245.16

The beams, bricks, anchor bolts, and most of the miscellaneous items for the entire battery are on the grounds, "Commercial" Rosendale and "Atlas" Portland cement are being used.

Rosendale cement is estimated to cost the contractor per barrel delivered in shed, 80 cents.

Small broken stone is estimated to cost the contractor per cubic yard delivered in bin, $2.10.

A cubic yard of Rosendale concrete rammed in place, measured loose, contains:

	Cubic yards.
1¼ barrels cement (packed)	19
Sand	39
Broken stone	97

The proportions of the Rosendale mortar are 1 cement, 2 sand

Portland concrete—1 cement, 3 sand, 5 broken stone.

The mixers make 14 revolutions a minute, and 20 to 22 revolutions a batch.

The contract cost of Rosendale concrete in place is:

Cement	$1.50
Broken stone	2.86
Mixing and placing, complete	1.65
	6.01
Estimated cost to contractor exclusive of his superintendence and plant is	4.87

The contract cost of Portland concrete per cubic yard in place is:

Cement	2.65
Broken stone	2.86
Mixing and placing, complete	1.65
	7.16

The cost of granolithic finish per cubic yard, $10.20.

The contract price of large stone is $7.17 per cubic yard.

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It is estimated to cost the contractor $4.81 per cubic yard.

The concrete in the first emplacement has been brought up to the height of about 20 feet above magazine floor at the most advanced, and of 8 feet at junction with second emplacement. Work on the latter has just commenced. The details of the work are given in the specifications.

The total expenditures for engineering, supervision, and office expenses have been $4,550.91.

The Engineer Department staff, besides myself, consists of 1 draftsman and clerk, 1 cement tester, 1 inspector, who is an engineer and gives the lines and superintends the construction of forms and excavation, 1 inspector, who is constantly on the battery inspecting the placing of the concrete, 1 inspector at the mixer and cement shed, 1 recorder, who inspects the receipts of the materials, 1 messenger, and 1 boatman. Considerable material has been received at night lately and the messenger has been acting as a substitute recorder. The location of the battery was made by referring its position on the project map, which was an old chart not showing triangulations, to the longest line common to that chart and the survey made last fall. Having laid it off on the ground, concrete stations with brass pipe center were established in elevated points outside of the masonry in the line of the centers of the guns. This line is used as the axial line in laying off the details of the work. It is the intention to fix by brass pipe a point on the top of the flank emplacement in this line, which will be visible from several stations of the system of triangulation now used in all Cape Fear River surveys.

The grade of the magazine floors is 9 feet above Baldhead mean low water. The mean tidal range being 4.5 feet.

Borings made at the site of each of the gun platforms to a depth of about 30 feet below mean low water indicated a sand and shell foundation with several layers of mud, aggregating in thickness about 6 inches.

Recent levels indicate a settlement of about one-sixth inch in the older parts of the emplacement. No cracks have as yet become apparent. For making cement briquets, a machine was made patterned after the one shown in Report Chief of Engineers, 1896, page 516. It was used several months, and similar series of briquets were made by it and by hand.

The latter tested higher and all briquets are now made by hand. The materials are mixed and placed in the mold, then rammed by one hundred and fifty blows with a light wooden mallet on a wooden briquet-shaped piston, guided by a second mold above the first. The quantity of water used in mixing is such that water appears between the fiftieth and seventieth blows. A Fairbanks machine with clips having rollers at their ends is now used to break the briquets.

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3 L.

DEFENSES OF COAST OF SOUTH CAROLINA.

Officer in charge, Capt. Frederic V. Abbot, Corps of Engineers, with Lieut. Edwin R. Stuart, Corps of Engineers, under his immediate orders since September 30, 1896; Division Engineer, Col. Peter C. Hains, Corps of Engineers.

Mortar battery.—For history prior to June 30, 1896, see page 508, for description of well point method of controlling water in foundation excavations see page 509 to 512, for costs to that date, page 512, and for description and history of quarry, page 513, Annual Report of the Chief of Engineers for 1896.

ABSTRACT OF WORK DONE DURING PAST FISCAL YEAR.

On June 30, 1896, the plant was nearly ready for active work, and the pile driving for foundations of 7 of the 16 mortar platforms had been finished. No piles had been cut off to grade.

Actual concrete work began on July 10, and was completed, except for flooring and bedding index rings on March 16, 1897. During this period of two hundred and sixteen days (excluding Sundays and holidays) 15,562 cubic yards had been put in place.

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All material excavated for foundations was deposited in the parapets as fill, but the ground on which the battery stands is so low that the parapets were practically all fill. Sand filling began in earnest on August 6, and was completed on March 29, 107,816 cubic yards having been deposited in two hundred and twenty-seven working days estimated as above.

Mud work to protect the sand from erosion by the wind began experimentally on December 18, 1896, but was postponed on account of the difficulty of controlling new gangs of negro laborers during the Christmas season, and because of exceptionally bad weather till February 8, 1897. Between that date and May 6, about 9,000 cubic yards of mud were deposited on the slopes and top of the sand parapets, forming a very efficient protection.

Sodding aggregating 1,388 square yards was placed round the tops of the mortar pits and on the very steep rear slopes, during April and May.

On June 30, 1897, the battery was ready for service, with the exception of floors and index rings around the mortars. The latter were not set till after the platforms were releveled, and this was postponed till after testing the mortar platforms by actual firing with service charges. This firing may develop difficulties in keeping the platforms level, in spite of their pile and grillage foundations, and may necessitate permanent arrangements for adjustment of the base rings without the necessity of tearing up the surrounding concrete, as is required with the pattern now supplied.

Had it not been necessary to wait for settlement to cease, before putting in floors and drains and setting the index rings, the battery would have been ready for transfer to an artillery garrison by the middle of May, 1897. It could have been used in actual defense at any time after January 1, 1897, if the necessity had arisen.

GENERAL ENGINEERING FEATURES.

Foundations.—The method of putting in the grillage and concrete foundations for the mortar platforms in the southwest pit, 8 feet below the level of standing water in the soil, by the use of well points in place of cofferdams was described on page 509 et seq. in the last Annual Report, and was followed in the three other pits with entire success. No difficulty was found in keeping the water out of two pits 45 feet square at the same time by the use of the plant therein described. The pump was an old combined air and circulating pump of the Knowles make, formerly connected with a Wheeler surface condenser having 800 square feet of cooling surface. It had a single steam cylinder between two water cylinders, each of the latter having 4-inch suctions and corresponding discharges.

As soon as each pit was excavated the piles were cut off and were capped with a grillage of very heavy dock timbers. The grillage was composed of twelve 40-foot timbers, sixteen 17-foot timbers, and eight 10½-foot timbers in each pit. The timbers crossed each other at right angles, each intersection being vertically over a pile. A heavy drift-bolt was driven through the timbers and well down into the head of each pile. The four mortars in each pit are thus connected together and their foundation is made a unit.

The excavation was carried low enough to permit ramming concrete thoroughly under the grillage timbers and around the heads of the piles. The concrete was then brought up to a level a few inches below the heads of the anchor bolts, and a narrow strip around the edge was

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brought up a little above the water level in the soil, so as to form a levee of concrete. In this way the anchor bolts could be set in the dry after the pump had stopped. To cut off the 124 piles in each pit took about two days. The grillage in each pit required about ten days, and the concrete up to the level of the anchor bolts, including the levee, about two days. As the excavation itself required about a week, the whole time the pump had to run night and day was about three weeks. No trouble in so doing occurred. The cost of pumping and piping (pump and boiler not included, as the plant was on hand and would have been needed with cofferdams) averaged about $200 for each pit. In the treacherous quicksand actually encountered cofferdams would have cost much more. A photograph* is appended which shows the appearance of the foundation of the southwest pit a short time after the pump stopped and before the water had risen to its natural level again.

No piles were driven under the battery walls, reliance being placed on the layer of about 13 feet of sand to distribute the loads uniformly to the underlying mud which extends to a great depth below the whole site.

Settlement.—The object kept in view was to make the foundation of the mortar platforms as distinct as possible from that of the rest of the battery. This has been accomplished, as a general subsidence of the battery, amounting to about 14 inches, has occurred, while the mortar platforms have not settled appreciably. The general disturbance has thrown them about half an inch out of level.

The settlement of the northern half of the general structure has been very uniform, that of the southern half less so. This difference is the result of the impossibility of applying the sand loading to the south half of the battery with any approximation to uniformity. The orders to have the battery ready for service by December 1, 1896, necessitated the beginning of parapet work within a month after concreting had begun. In this way the sand had, at the beginning, to be crowded close to the fresh concrete, before the latter was hard enough to stand roofing over. After the south half of the concrete in the battery had been completed the concrete work was sufficiently far in advance of the sand to permit roofing before the heavy fill approached too close. Sand was then deposited in layers, about 10 feet thick only, all over and around the concrete and irregularity of settlement was avoided. While the result of building the battery so rapidly has been to make the ceiling of the passages deviate somewhat from a true plane, the rate of settlement, since the entire load of sand has been applied, is very uniform over the whole area. The vertical cracks which had generally developed at the planes of weakness as the sand filling progressed were carefully grouted as soon as levels showed that unequal settlement had stopped, and this grouting has not cracked since. The whole interior of the battery now presents a most satisfactory appearance and the only lasting bad effect of the excessive subsidence is the difficulty of providing as satisfactory drainage as was intended. The loss of a foot and a quarter of slope from the floor levels to the high-water mark at the outfall of the main drain necessitates considerable work in manholes, silt basins, and gates that would have been unnecessary with the slope as originally designed.

No leaks have formed in the roof. That the concrete walls have not been forced down to any great extent into the sand layer, but that the

*Omitted.

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sand itself has been depressed, is proved by the fact that as sand filling approached any concrete wall the latter settled. For instance, the walls of the west magazine did not settle at all till the west parapet filling began. By the time that the foot of the slope of the western sand parapet reached these walls their western end had settled three-tenths of a foot, while their eastern end, 70 feet farther from the parapet, still remained at the original level. The depression of the whole sand layer is again proved by three bench marks in the main passageway. These are iron pipes bedded in about a half yard of concrete each, and are located on the center line of the main passageway at its middle point and where it intersects the two cross passageways. These bench marks are a little below the level of the floors and are separated in a horizontal direction from the neighboring walls by at least 4 feet of loose sand. The table below shows their settlement as compared with that of the adjacent walls.

Settlement table.

	Settlement at—		
	South cross passageway.	Center main passageway.	North cross passageway.
	Foot.	*Feet.*	*Feet.*
Walls	0.90	1.05	1.12
Bench mark	.70	.92	.72
Difference	.20	.13	.40

The rate of settlement is greatly decreased at all points. Carefu measurements will be taken before and after the discharge of each of the mortars to determine not only the effect their firing has on their own platforms, but also the effect, if any, upon the levels elsewhere in the battery.

Precautions against damage by settlement.—As unequal settlement was anticipated, the walls were divided into sections 40 feet long by vertical planes, which were continued through the roofs where these rested on the walls. The planes of weakness were formed by building alternate sections of the walls with the casing at the ends vertical. When the blocks thus formed had set, the end casing was removed and the intermediate blocks were built, the new concrete abutting directly against the old. The same system was followed in the roof, its planes of weakness being carefully formed in continuation of those in the supporting walls. In almost every case the subsequent sand loading caused these joints to open. Some cracks occurred elsewhere than at the prearranged points, and 30-foot sections would probably have been better than the 40-foot sections actually employed. The roof was made watertight at the planes of weakness by slip joints. These consisted of a continuous sheet of yellow metal about 14 inches wide and extending across the roof from eave to eave, so laid as to project 7 inches on each side of the division plane. The sheet of metal was then covered with the waterproofing coat of Portland cement and sand (1 cement to 1½ sand), which was used for the entire roof. This coating has proved most effective in shedding water. In spite of the settlement there has been no indication of any leak in the roof, even during the prolonged and heavy rains of last January and February. During this period the ceiling and walls were dryer than in clear weather, as there was then little or no atmospheric moisture condensed on them.

Ventilation.—In wet weather the whole interior of the battery is dry.

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In dry weather much surface condensation has occurred. During a twelve-hour test of the electric plant, fans were in operation drawing air from the cold weeper galleries (which communicate with the main passageway) and forcing it into the magazines and relocator room. While the duration of the test was too short to prove a great deal, the magazines and relocator room, which were very wet at the start, appeared decidedly drier at the end than at the beginning of the twelve hours. This indicates that the moisture in the air forced into the magazine had been removed by condensation during its flow past the cold walls of the narrow and crooked weeper galleries.

In providing ventilating apparatus for the powder magazines and relocator room, the special object was to cause condensation to occur outside of these rooms. Success has apparently been attained. The fan in the dynamo room is solely to moderate the heat, and is reasonably effective, although the room is too hot for comfort even while the fan is running.

Proportions used in concrete.—Much study was devoted to the proportions of materials in the concrete, the effort being to find the mixture which would give the greatest density and strength with the least cement. The mixtures tabulated below were used in sufficiently large masses to give a real test in actual work, the more doubtful proportions being used where the requirements of strength were the least. No. 6 proved the best, but it was found difficult to get the crusher to supply the granolithic size of stone in this ratio to the larger size. When the granolithic gave out mixture No. 7 gave very good results.

Proportion table.

[Nos. 1 to 8 Rosendale; 9 to 13 Portland.]

No.	Where used.	Cement.	Sand.	Gravel (coarse sand).	Granolithic stone.	Broken stone.
1	Platform southwest pit	1.5	0	2	0	3
2	Other 3 platforms	2	0	2	1	4
3	West magazine walls	1	0	2	1	3
4	West magazine walls later	1.5	0	3	2	4
5	....do	1.5	0	3	1	5
6	All other walls	1.5	4	0	1	4
7	All other walls (if necessary)	1.5	4	0	0	5
8	Foundations of columns	1.5	4	0	0	5
9	Portland ring under base rings	1	0	1	2	0
10	Inch next base rings	1	0	1	0	0
11	Floors under carriages	1.5	0	2	2	0
12	Waterproof coat for roof	1	0	1.5	0	0
13	Bearing for roof beams	1	0	1	0	0

Parapets.—The sand used for parapets was mostly silicious and excessively fine grained. It would be hard to find a material better adapted to resist the impact of projectiles, as it acts almost like a fluid, and shot should seek the line of least resistance and turn upward after entering. To keep the sand in place long enough to complete the parapets was difficult. A windy day in dry weather moved astonishingly large quantities, and the flying sand was so blinding that work anywhere in the battery was really interfered with to a considerable extent. The sand was to be paid for in place in the finished embankment, and the contractor went so far as to buy a pump to save himself from the loss of material. It is needless to say that one attempt to use it was all he made, as it was impossible to keep such an area of sand wet at any reasonable cost for labor. A better plan which he successfully used later was to set up flashboards at the top of the slopes. They caught the sand as it was blown up the inclined surface. Even after the inclined concrete walls around the mortar pits were completed several

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hundred cubic yards of sand from the top of the bombproofs drifted down into the pits, one mortar in the southeast pit being on one occasion almost completely buried.

It was evident that such a material must be covered as soon after being put in place as possible. Sodding was out of the question, as the drifting sand would bury and kill it before it could root, and the expense would have been too great. The material actually used was the salt mud from the marsh adjacent to the back of the battery site. It was dredged by the Government clam-shell dredge, which deposited its load into a hopper, beneath which 2-yard dump cars were run. The cars were hauled up a long trestle to the top of the parapets, and were dumped along the exterior crest. The actual difficulties encountered and successfully overcome are discussed in detail in the appended report of my assistant, Lieut. E. R. Stuart, who was detailed to study up the best method of applying the mud. The top was covered with mud, as well as the slopes, except for a space of 8 feet around the tops of the pits. Here sodding was used, as large quantities of mud running down over the newly finished concrete slopes might have injured them, and would have been expensive to remove from the pits afterwards. As the mud dries it cracks, and can then be brought to a uniform surface for a reasonable cost. The layer is about 2 feet thick, and forms a rich soil as soon as it has "sweetened" by having the salt washed out by the rain. It cost 30 cents a yard in place, including barricades, or only a little more than the sand.

Drainage.—The site of the battery is so low that water used to stand there like a pond during the rainy part of the winter. This was to a considerable extent prevented last winter by a system of surface ditches around the outside of the battery, but in spite of this, water rose to the surface of the sand in the magazines and passages, which was about a foot below the final level of the finished floors. The whole system of floors and drains in the battery had been postponed on account of settlement. There would have been no use in trying to construct the finished drains, as they would have soon gotten entirely out of level. The floors could not be built till their underlying drains had been finished.

The settlement has now been so much reduced in rate, and the latter is so uniform over the whole area, that the subsoil drains in the passageways have been constructed. They discharge into a large silt basin in the rear part of the northeast pit, and from this the discharge flows through a 10-inch vitrified-pipe drain to the basin at the head of the canal. The cunette which carries the rain-water flow from the mortar pits through the main passage to the northeast pit discharges at a higher level into the same silt basin. Where the pipe leading from this basin to the canal passes through the 12-foot level levee at the battery entrance a bronze gate is placed to exclude water in case of storm tides, which overflow the whole site and rise above the level of the magazine floors. The pipe drain is provided with ample manholes and can be cleared out with a hose and force pump which is in the dynamo room. This pump is also connected with a large wooden tank located at the north end of the bombproof cover of the main passage, about 15 feet above any point on the top of the earthwork. Pipes with valves and hose nipples extend from this tank to convenient points for watering all the earth slopes. This work is performed by the day watchman, and really costs nothing, as the fuel is required to keep the electric-lighting plant in order. The company which installed this plant advised me to have it run for several hours every week. If this is not done the ironwork will rust, and the dynamo is liable to become so damp as to produce short circuits and burn out.

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An effort has also been made to keep the reservation outside of the battery dry by means of subsoil tile drains which discharge directly into the canal. Open drains are out of the question, as they fill up with drifting sand after a few days of dry weather.

ACTUAL CONSTRUCTION.

Plant employed and its arrangement.—For foundation work under mortar platforms the following plant was used: One steam pile driver with leader timbers high enough to drive 40-foot piles; one oak follower 10 feet long; the pump described under the head of foundations and forty 1½-inch well-points connected to each suction when two pits were pumped at once. This plant was in use about two months in all. For the rest of the work the following plant was provided: One 20-horsepower hoisting engine and boiler; one derrick and five elevated stone pockets holding about 250 tons of crushed stone each (all five in reach of the same derrick); one cement shed holding 5,000 barrels of cement; one canal leading to the battery site; three wharves on the island (one new one at the head of the canal and two old ones in the cove); a railroad wharf in Charleston furnished by the railroad company hauling the rock; 1 blacksmith shop at the battery site; 1 good tug; 8 good 200-ton lighters; 1 steam derrick scow equipped with an efficient 2-yard clam-shell bucket; 1,000 linear feet of elevated railroad trestle; 2,000 feet surface track; 1,400 linear feet Hunt's standard railroad track, switches, curves, 2 turntables, 6 tip cars, and 3 flat cars; 10,000 square feet concrete casing in the shape of flat doors 10 feet high and 5 feet wide; between 30,000 and 40,000 square feet rough plank casing; 1 concrete-mixing engine, which was originally a 15-horsepower double-drum hoisting engine with boiler (the pile-driver engine hauled cars up two inclines after finishing pile driving); at the quarry, 1 No. 3 Gates stone crusher, with elevators and revolving screens and a complete set of storage bins holding 125 tons of crushed stone (for drawing and ground plan, see p. 516, Annual Report of the Chief of Engineers, 1896); 1 wire-rope trolley; 3 derricks; two 25-horsepower hoisting engines, double drum, double cylinder, each with a boiler; 1 good high-speed 45-horsepower engine and boiler; a complete blacksmith shop and outfit; 3 steam drills of the Ingersoll-Sergeant pattern, 3½ inch cylinders, and the necessary quarry pumps, crowbars, electric exploders, dynamite magazines, and all minor arrangements and appliances needed in a convenient and efficient quarry plant.

The sand contractors' plant consisted of an ever-varying assortment of second-hand engines; of four steep inclines (trestle) leading from the site to the top of the parapets; about 30 dump cars of the pattern dumping both sides at once; 4 large swiveled side-dump cars; 5 heavy 2-yard iron tip cars; 1 locomotive; about a mile of 3-foot-gauge track; and from 6 to 10 horses.

At the quarry the plant was arranged as described in the report of Lieut. E. H. Schulz, Corps of Engineers, pages 512 to 515, Annual Report of the Chief of Engineers for 1896.

At the railroad wharf in Charleston the stone was transferred by hand from the cars to the lighters. The lighters were towed to the mouth of the canal by the Government tug, were poled up the canal to the wharf (taking advantage of the tide), where they were unloaded by coal buckets with the derrick above described. Cement was rolled on gang planks from the lighter to the wharf and thence directly into the cement shed, which was built with its length parallel to the length

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of the wharf. Under the stone bins a track was laid on which ran the tip cars used to convey properly proportioned dry materials to the concrete mixer. After passing under the bins the car was turned on a turntable, and passing through the end of the cement shed received the proper charge of cement. It received the sand charge at a platform between the cement shed and the incline to the mixer. Had the United States possessed the title to the Francis Thompson lot when the plant was being constructed the mixer would have been erected on this lot close to the cement shed, and an elevator would have been used with advantage instead of the incline 550 feet long. When the car reached the mixer, its contents were dumped into a hopper and fell into a 4-foot cubical mixer which had already received the proper water charge from a tip tank so graduated that the proportion of water could be modified according to the condition of sand and stone. The contents of the mixer were discharged by gravity into a tip car below, and as long as work was on ground level it was pushed to its destination by hand. Later the cars were pulled up the incline leading to the first level of overhead trestle by a rope operated by the spool head of the concrete-mixing engine. When a two-story trestle was needed, the former pile-driving engine operated this high incline and another to convey large stone and steel beams from the wharf to the upper levels of the concrete work.

The arrangement of the sand contractors' plant was as follows: At first they had an incline from the level of the site to the top of the western parapet. From the foot of this incline a number of tracks radiated, and on them side-dump cars were loaded by hand. Only about 2 feet in depth could be spared from the surface of the reservation, which was here quite flat. The cars, filled with sand, were hauled up the incline and there automatically dumped into a large hopper by a stationary engine and steel-wire rope. Beneath this hopper there was a track running parallel to the top of the parapet. On this track ran two swivel-dump cars, which were filled from the hopper and pushed by hand along the track and so dumped that their contents slid down the steep front slope of the fill. The tracks were extended as the filling advanced. Much trouble was experienced from the advanced end of this track settling under the loaded cars, and whenever this occurred the cars became uncontrollable and rolled to the bottom of the slope. A second incline was subsequently erected to build the south parapet and a third for the east parapet. The last two inclines were largely fed with sand brought from a distance of about half a mile, as the supply on the reservation was by that time exhausted. When sand was deposited on top of concrete work, trestles were built, and the sand was thus dumped and distributed as uniformly as the conditions permitted.

Personnel.—At the quarry the day force consisted of 1 quarry master, 1 clerk, and 54 mechanics and laborers; at night a second and smaller force of laborers worked under the same supervision as the day gang. Night work was resorted to only when more than 120 tons a day was to be shipped. The labor cost of quarrying, crushing, and loading cars at the quarry was 60 cents a ton.

At the railroad wharf in Charleston stone was unloaded from cars and placed on lighters by 1 overseer and 9 laborers. The cost per ton was 11 cents. The cement contract called for the delivery of cement on board Government lighters. For this it is believed that the contractor paid three-quarters of a cent per barrel. The tugboat had a crew of 8 men. Four laborers poled the lighters up and down the canal. The cost of this transportation from the city to the site was 16 cents per cubic yard of concrete in place in the battery.

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On the wharf at the battery supplies were unloaded by 1 suboverseer and 12 laborers. Unloading stone into the elevated bins cost 7 cents a ton; gravel, 4 cents a ton; cement piled in the warehouse five tiers deep, a little less than 1 cent a barrel. One overseer and 40 men constituted the force actually employed in concrete work proper. Of these, 14 laborers did the actual placing and ramming. The other 26 measured the materials into the cars, transported them to the mixer, made the concrete, and transported it to the desired place of deposit. This labor cost 45 cents a cubic yard of concrete in place.

The waterproof covering for the roof, the granolithic concrete forming the gun platform proper (replacing the cut-stone work used in some batteries) and the Portland cement bed for the roof beams were put in by a plastering gang, composed of 2 skilled white masons and 3 negro assistants. They also gave the walls a coat of Rosendale grout, about as thick as whitewash, and plugged any holes where stone had been accidentally left near the casing. The labor cost of waterproofing was 23 cents a square yard; of 1 gun platform complete, $27; of surfacing the walls, from 13 to 25 cents per square yard, depending on the situation.

The ordnance was delivered by the Quartermaster's Department within 100 feet of the pits to which it pertained. It was moved into final position and assembled by 1 overseer and a force varying from 10 to 20 men, depending on the weight of the pieces handled. By this force the base rings were put in approximate position, supported on heavy timbers blocked up to the proper height, and the anchor bolts were hung in position from them. They thus placed two base rings in one day of eight hours. The regular concrete gang then bedded the anchor bolts in the concrete and brought the latter up to the level of the ring stones. The ordnance gang then jacked up the base rings about 2 feet, and the plastering gang built the Portland cement concrete which replaces the usual cut granite. The ordnance gang then lowered the base rings into exact position, adjusting them to level so accurately that there was no error greater than one one-thousandth of a foot. They then drove in the finishing or bedding layer, of Portland cement 1 to gravel 1, which completely filled the space 1 inch high which had been left between the bottom of the base ring and the top of the ring-stone work done by the plastering gang. The extreme accuracy of leveling and the great care taken in filling the 1-inch space rendered this a slow process. Each of the following items constituted an eight-hour day's work for the ordnance gang: Setting 2 racers on the base ring; putting 2 cheek pieces in place; moving a mortar 75 feet and mounting it. To mount 4 mortars from the concrete up required about three weeks, and cost for each mortar $40. This does not include the cost of material for the anchor bolts, nor the labor and material for constructing the Portland ring stones of the platform. For details of method of mounting, see appended report of Lieut. E. R. Stuart.

A force of 1 master laborer and 7 laborers was kept busy cleaning up the carriages and mortars and assembling the smaller parts both before and after the mortars were mounted. Each of the 16 carriages cost about $65 for cleaning. A mortar and carriage cleaned and mounted thus cost, from the concrete platform up, close to $105 for labor.

The dredge was operated by 1 master laborer and 7 laborers. They were paid by the United States while deepening and trimming the banks of the canal, the labor cost of this work being about 2 cents a cubic yard dredged. When supplying mud for the top and slopes of the battery, they were paid by the mud contractors, and their cost is included in the price they bid for mud in place.

The carpenter gang was the largest and most unsatisfactory connected

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with the work. A first-class master carpenter and 3 good carpenters were secured; the rest, about 40 in number, were generally very poor. All the casing for concrete and the long, high trestles and inclines for concrete cars were built by this gang. Charging all its labor directly to concrete work, the cost was 47 cents per cubic yard in place.

A suboverseer and 24 laborers were kept employed in general heavy work—moving timber, pulling down old houses, wheeling sand, excavating for foundations, etc. Charged directly to concrete work, its work cost about 12 cents per cubic yard of concrete in place.

There was 1 superintendent in full local charge; he was assisted in the field by 1 assistant engineer and 1 rodsman, who did most of the laying out, and by a receiver of materials, who was responsible for the safety of tools and material on hand, and receipted for new material upon its delivery. The superintendent had also an office force, consisting of 1 clerk and 1 cement tester. The latter was assisted by 1 laborer, who did the heavy work in taking cement samples, ran errands, swept the office, etc.

Two night and 1 day watchmen were required to pump loaded lighters, take hawsers at the wharves, and do other usual watchman work. The above personnel was engaged for eight hours a day, except those given in the next to the last paragraph, who worked sixteen hours per day, and those in the last paragraph, who worked twelve hours per day. Concrete work was continued by a second shift of laborers and foremen, equal in number to those given above. By care in selecting men and the use of suitable lights, night work was made equally rapid, equally good, and equally as cheap as day work.

When it was found that sand work and concrete work must be carried on simultaneously in order to complete the battery on time, it became apparent that the superintendent could not possibly personally direct such a large force of laborers as would be required. A reasonable offer to supply sand in the parapets having been received in answer to an informal call for proposals, it was deemed best to accept it, and the parapets were thus put in without any increase in the supervising force. This was possible because all the extra work necessary was setting the slope stakes and measuring once a month the quantities of sand fill. This the assistant engineer did in addition to his other work.

The contractors were conscientious and reasonable, and even at disadvantage to themselves conducted their work so as to interfere as little as possible with the concrete work. Friction between their negro laborers and ours was anticipated, but never became sufficiently pronounced to cause serious trouble. To prevent anything like rioting, if such trouble began, the Government superintendent and overseer were sworn in as deputy sheriffs of Charleston County. This proved very efficacious on several occasions, as negroes are much afraid of officers of the law.

The sand contractors' agreement called for the completion of the parapets by December 1, 1896, but they were unable to supply the quantity of sand required before March 29, 1897. This was not entirely their fault, as they were somewhat delayed at the start by the condition of the concrete work at that time.

Delivery of ordnance.—Ordnance material was delivered by the Quartermaster's Department as follows:

Seven mortars and seven carriages were received in Charleston late in May, and were finally received at the site early in July.

Four West Point foundry carriages were delivered at the site during August.

The eighth mortar and the twelfth carriage reached Charleston early

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in October and were delivered at the site late in that month. The late arrival of this mortar and carriage delayed the completion of the eastern parapet seriously.

Four Watertown carriages were delivered at the site in December.

Eight mortars are still undelivered.

Progress of work.—June 30, 1896: The plant was ready. A thousand tons of crushed stone was stored in the bins at the site. A cargo of cement had been received. Two hundred and seventeen piles had been driven. Excavation for foundation of mortar platforms in southwest pit had been completed.

July 31, 1896: Pile driving finished. Grillage in two pits completed. Concrete in southwest pit up to level of base rings. Western magazine ready for roof.

August 31, 1896: Grillage and concrete foundation in three pits finished. Excavation for fourth pit finished. Base rings set in southwest pit. Main passage walls on west side well advanced. Eleven thousand five hundred cubic yards of sand in place in south and west parapets.

September 30, 1896: Southwest pit complete except inclined concrete revetment. Mortars mounted. Northwest pit, carriages in position, no concrete walls around the pit. Southeast pit, foundation for mortar platforms complete up to level of anchor bolts, base rings in position on timber supports ready for bedding anchor bolts. Northeast pit, foundations complete to level of anchor bolts. No further work on foundations possible till base rings arrive. Concrete work of south cross passage and south half of main passage complete except roof. West magazine, shell room, and anteroom complete except roof. West parapet complete to within 7 feet of full height. South parapet two-thirds complete. South cover to west magazine one-third complete. Sand between southeast pit and southwest pit level with the top of the walls.

October 31, 1896: Southwest pit as above. Northwest pit complete except inclined concrete revetment. Southeast pit, three vertical walls complete, base rings set. Northeast pit, two vertical walls complete, mortar foundation as before. Main passageway, walls complete, steel roof beams in position, trolley beams in place, 69 linear feet of roof complete. West magazine, steel roof beams in position, 55 linear feet of roof complete and covered with sand. East magazine, walls complete. North cross passage, walls complete, steel roof beams in place. South cross passage, walls complete, steel roof beams in place. Concrete retaining wall in rear of battery complete. West parapet complete ready for mud. South parapet, west half complete ready for mud, east half embankment half completed. Eastern parapet well started. Interior spaces of battery, sand filled to the tops of the walls.

November 30, 1896: All concrete work in the battery completed except floors, inclined revetment around mortar pits, and a little roofing. Trolley system ready for use. Electric-lighting plant on hand but not installed. Western parapet and sand cover of western magazine complete. South parapet nearly complete. Sand cover of eastern magazine half complete. East parapet complete except for gap left to permit entrance of last mortar and carriage. Whole battery is sufficiently advanced to permit fighting; all the ordnance material on hand.

December 31, 1896: Concrete work completed, with exception of floors and part of the inclined revetment around the two northern pits. Electric-lighting plant, installation well advanced. West, south, and east parapets complete, except mud covering. Rear parapet begun. All ordnance material on hand mounted. Trestle for mudding the top and slopes of the battery ready for use.

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January 31, 1897: Battery complete, except for one-fourth of the sand in parapets, the mud covering of the parapets, and such minor concrete work as could not be done till sand work was further advanced and settlement decreased.

February 28, 1897: Concrete work as above. Sand work seven-eighths completed. Mud work one-third completed.

March 31, 1897: Concrete as above. Sand work completed. Mud work two-thirds completed. Government plant turned over to the contractor for the 10-inch battery. All employees, except the watchmen, were discharged. Rate of settlement diminishing. Boiler of electric-lighting plant rejected as too small.

May 6, 1897: Concrete, sand, and mud work completed as far as possible till the rate of settlement diminishes and the mud is dry enough to dress.

May 31, 1897: Sodding around the pits completed. Rate of settlement so much decreased that drainage work can begin.

June 30, 1897: Main drain with three manholes and a suitable bronze gate complete. Subsoil drains through main passage and both cross passages in place and operating successfully. Rate of settlement much diminished. Mortar pits cleared of sand which had been blown in from the parapets before mud was applied. Twenty 800-pound shell and necessary primers for eight rounds received. Six hundred pounds of mortar powder and the oil needed to fill the recoil cylinders of the mortars on the way, but not delivered.

AMOUNTS EXPENDED AND COSTS PER UNIT.

As the plant was ready for use on July 1, 1896, the cost of preliminary work is largely covered by expenditures made and reported in the previous fiscal year. To make the following statement complete these sums are included in the two columns on the right of the following table. Some of the plant was originally purchased for another battery and paid for from that allotment. The total columns contain all such items, as the real cost of the work done at the mortar battery is what is desired, and not the money payments that were by accidental transfer made from one allotment or the other.

Plant and work incidental thereto.

List of plant.	Fiscal year 1897.		Total labor.	Total material.
	Labor.	Material.		
General supplies at quarry		$951.75		$2,630.86
Repairs to plant at quarry		721.34		721.89
Machinery and bins at quarry		472.84	$2,974.28	4,532.16
Repairs to tug and lighters	$281.45	627.76	1,064.06	1,018.55
Expenses of tug	1,632.50	712.84	2,875.25	1,234.30
Dredging and piling in cove		385.00		2,099.53
Repairs to wharf				45.00
Canal to site	462.25	106.25	522.75	7,367.66
Wharf at site		166.28	133.00	1,488.39
Derrick at site			219.37	45.00
Stone bins at site			610.92	663.98
Cement warehouse at site			586.97	768.22
Mixer frame and its 560-foot incline			266.27	159.61
Machinery and appliances at site	117.13	3,581.41	125.63	9,660.27
Repairs to plant at site	759.13	578.84	867.40	961.66
Trestles and railways at site	1,347.27	259.38	1,347.27	259.38
Pile driver			119.63	117.69
Drainage (temporary)	94.01		222.90	18.00
Pumping outfit	7.00	82.39	165.64	200.32
General supplies at site		1,263.00		1,735.21
Total for plant	4,700.74	9,909.08	12,101.34	35,727.68

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Of the above expenditures, the sum of $6,976.82 was paid from another allotment.

Materials and labor in actual work.

Material or work.	Fiscal year 1897.		Total labor.	Total material.
	Labor.	Material.		
Miscellaneous (items unknown)	.....	.....	.....	$169.56
Cement on lighters	$450.47	$20,427.45	$515.47	23,055.62
Gravel at site	171.88	1,193.12	208.63	1,350.39
Stone at site	11,692.50	13,508.63	12,608.68	14,299.81
Sand in parapets	844.13	21,410.40	844.13	21,410.40
Mud on parapets	300.42	2,931.30	300.42	2,931.30
Sod around pit tops	.....	694.00	.....	694.00
Grillage and piling	2,553.96	414.79	3,874.95	1,022.32
Mounting mortars	1,892.80	211.36	1,892.80	754.36
Miscellaneous labor	2,871.61	.....	3,123.74	.....
Main and field offices	5,048.27	777.87	7,670.44	1,693.05
Casing for concrete	4,368.98	838.55	4,368.98	838.55
Mixing and transporting concrete	6,434.97	.....	6,434.97	.....
Ramming concrete	4,848.20	.....	4,848.20	.....
Placing big stone	951.13	.....	951.13	.....
Excavation	733.86	.....	733.86	.....
Grading around pits	980.74	.....	980.74	.....
Setting base rings	557.95	.....	557.95	.....
Steel and iron work	373.12	2,790.00	373.12	2,790.00
Waterproofing roof	997.06	86.61	997.06	86.61
Trolleys in place	148.64	1,668.00	148.64	1,668.00
Electric-light plant	92.93	*4,207.20	92.93	*4,207.20
Firing circuits	*486.05	*†350.00	*486.05	*†350.00
Permanent drains	*206.11	813.23	*206.11	813.23
Crow's-nest	32.69	.....	32.69	.....
Doors and hinges	.....	119.40	.....	119.40
Total material and work	‡47,038.47	‡72,441.91	52,251.69	78,253.80
Total for plant	4,700.74	9,909.08	12,101.34	35,727.68

* Partly outstanding liabilities.
† Approximate.
‡ Does not agree with money statement, as it does not include liabilities incurred before June 30, 1896.

SUMMARY OF ABOVE.

Total expended for plant	$47,829.02
Total expended for labor, material, etc. (including outstanding liabilities)	130,505.49
Total expended for all purposes (including outstanding liabilities)	178,334.51
Paid by another allotment	6,976.82
Paid by mortar battery allotment	171,357.69

Table of wages paid.

Monthly men at battery:	
Superintendent	$125.00
Overseer	100.00
Clerk	60.00
Watchmen	35.00
Assistant engineer	125.00
Suboverseers	$60 to 40.00
Receivers of material	40.00
Monthly men on tug:	
Master	100.00
Steersman	35.00
Cook	30.00
Coal passer	20.00
Steam engineer	90.00
Seaman	20.00
Fireman	30.00
Monthly men at quarry:	
Quarry master	$110.00
Machinist	50.00
Clerk	50.00
Steam engineers	30.00
Per diem (8 hours) men at site:	
Master carpenter	3.00
Plasterers	$1.75 to 1.50
Laborers	1.25 to 1.00
Water boys	.60
Masons	2.50
Carpenters	$2.00 to 1.50
Sand laborers (contractor)	.80
Per diem (8 hours) men at quarry:	
Blacksmith	2.50
Laborers	$0.80 to .50
Carpenter	1.50

Cost of materials, including towage, handling, and supervision.

Rosendale cement delivered in warehouse, per barrel	$0.93
Portland cement delivered in warehouse, per barrel	2.40
Gravel delivered in elevated bins, per bushel	.04
Stone, both crushed and large, per short ton in bins	2.00
Steel I-beams, per short ton	36.30

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Corrugated iron No. 20, per 100 pounds	$3.02
Trolley system (20 trolleys in place)	1,808.85
Electric plant in place ready for lighting	4,300.13
Piles at pile driver ready to be driven, each	2.20
Excavation below water level in soil, per cubic yard	.37
Grillage timber ready for framing, per 1,000 feet B. M	9.75
Sand in place in parapets, per cubic yard	.21
Mud in place on parapets (not dressed), per cubic yard	.36
Sod in place on parapet, per square yard	.50

Cost of concrete per cubic yard in place.

	In walls and roofs.	In platforms.
Casing	$0.41	$0.13
Materials	3.45	5.19
Mixing and placing	.42	.47
Ramming	.33	.47
Total	4.61	6.25

Comparison of costs—contract and hired labor.

Item.		Mortar battery (hired labor).	10-inch battery (contract).
Common concrete:			
Casing	cubic yard	$0.41	
Mixing	do	.42	
Ramming	do	.33	
		1.16	$1.60
Platform concrete:			
Casing	cubic yard	.13	
Mixing	do	.47	
Ramming	do	.47	
		1.07	1.60
Cement:			
Rosendale	barrel	.93	1.05
Portland	do	2.40	2.35
Pon Pon gravel	cubic yard	.91	1.35
Sand for concrete	do	.12	.35
Stone	ton of 2,000 pounds	2.00	2.50
Sand in parapets	cubic yard	.21	.25
Mud on slopes	do	.36	
Fertile earth	do		1.00
I-beams, steel	short ton	36.30	46.43
Corrugated iron	100 pounds	3.02	3.50

Total quantities of materials.

Concrete	cubic yards	15,578
Stone	short tons	16,065
Sand embankment	cubic yards	107,816
Sodding	square yards	1,388
Mud	cubic yards	8,752

Cost of mounting ordnance.—Sixteen carriages were assembled and eight mortars mounted on them for the sum of $3,205.11. This includes every expense in any way connected with the ordnance material from the time it was turned over by the Quartermaster's Department.

Grand total from the beginning of work on the battery:

Engineering, supervision, office expenses, and contingencies, including expense of holidays	$9,363.49
Plant and canal from the start	47,829.02
Labor and materials from the start	121,142.00
Total expenditures from the beginning	178,334.51
Of which another work paid	6,976.82

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The above total cost divided in proper proportion between parapets and concrete work gives—

Parapet material, per cubic yard	$0.40
Concrete, per cubic yard (includes ironwork and all machinery and electric plant)	8.07

Local features.—To properly apply the above tables of costs to making estimates of cost for other batteries the local surroundings, both favorable and unfavorable, should be taken into consideration. With this in view the following abstract of local features is given:

The most unfavorable local feature was the thick layer of underlying mud. This has been a constant source of anxiety from the time the original plans were drawn till the present time. Much expense was involved in the preparations made to avoid damage from settlement; when it began, the order of work had to be changed at short notice, so as to rapidly apply loads where the settlement was not as rapid as the average, and sand work well under way had to be stopped and the sand applied elsewhere wherever the local settlement became too rapid. The floors and drains could have been put in at very small expense if this could have been done while the regular concrete work was in progress, and the same was true of the concrete to support the index rings. It is believed that this trouble is well over now and the compressible underlying soil has been compressed nearly enough to establish anew the equilibrium between the weights it supports and its powers of resistance. That this is true of purely static pressures there can be little doubt when the levels taken every two weeks are studied, but what the effect of prolonged firing of the mortars in volleys will be is doubtful. Advantage will be taken of the trial firing about to be done to obtain the fullest possible data as to the changes of level, both absolute and relative. Ten thousand dollars is a small estimate of the extra cost involved in building a mortar battery on such a foundation.

Next to the mud subsoil, the high level of subsoil water was the most undesirable feature. It involved considerable expense for pumping, and still more in permanent drains, which are absolutely necessary to make the battery effective and safe. When the extra ditching and pumping needed during the rainy weather of last January and February are taken into consideration, $5,000 is not an overestimate of the extra cost of controlling the water in the soil.

The low level of the site, about that of high storm tides, made it necessary to build the whole battery as fill. This means about 75,000 extra cubic yards of embankment, most of which was composed of sand brought from over half a mile away from the site. This increased the cost of the battery about $15,000.

The site was about 2 miles from the nearest point at which a tug could land lighters. The cove was deepened and a canal about half a mile long was dredged through the marsh, so that the tug could bring the lighters to the mouth of the canal, and thence they could be poled at high tide to the wharf at the site. The cost was about $8,000.

The nearest available granite was at Edgefield, 144 miles distant from Charleston, and the railroad freight rate was 80 cents a ton. There were other quarries at Columbia, 137 miles distant, with a 75-cent rate, but they were controlled by private parties, who charged 20 cents a ton more for crushed stone f. o. b. cars than it cost the Government to crush and load its own spalls at Edgefield. Advantage was taken of the presence in the United States quarry of about 5,000 tons of clean spalls, resulting from the use of this quarry to supply riprap stone for the Charleston jetties.

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The nearest cement market was New York, and the cement had to come by schooners. This necessitated a large cement warehouse and, when schooners were late in arriving, occasional purchases in lots of as much as 1,000 barrels from the local market in Charleston. The Charleston price f. o. b. Government lighters was about 8 cents a barrel higher than the New York price so delivered.

All iron-work had to come by rail from more than 1,000 miles, and the delivery was slow and uncertain and the freight high.

The common labor market was better than the average, but skilled labor was almost unattainable. A well-trained, reliable, and efficient force of foremen and suboverseers, and an exceptionally skillful and efficient superintendent, Mr. R. T. Crawford, and an active and accurate young assistant engineer, Mr. W. A. Leland, were made available by the recent completion of the extensive work on the jetties here.

The United States had on hand at Charleston all the floating plant needed for transporting supplies from the city to the battery site, a good steam derrick scow, and two hoisting engines. At Edgefield it had a good quarry and all the plant needed for getting out the large rock which were to be bedded in the walls. A crushing and elevating plant had to be purchased and installed.

Money statement.

July 1, 1896, balance unexpended	$26,906.27
Amount allotted August 11, 1896, act June 6, 1896	50,000.00
Amount allotted October 5, 1896, act June 6, 1896	50,000.00
Amount allotted December 16, 1896, act June 6, 1896	12,000.00
	138,906.27
June 30, 1897, amount expended during fiscal year	133,029.18
July 1, 1897, balance unexpended	5,877.09
July 1, 1897, outstanding liabilities	5,234.78
July 1, 1897, balance available	642.31

Amount and date of all allotments for this battery.

Date of allotment.	Date of act.	Amount.
February 14, 1896	Mar. 2, 1895	$60,000
August 11, 1896	June 6, 1896	50,000
October 5, 1896	.....do	50,000
December 16, 1896	.....do	12,000
		172,000

REPORTS OF FIRST LIEUT. EDWIN R. STUART, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Charleston, S. C., June 30, 1897.

CAPTAIN: I have the honor to submit the following annual report upon the subject of protecting the slopes of the mortar battery from the action of the wind:

The parapets of the mortar battery are composed of very fine-grained sand, which shifts in position easily under the action of the wind, and some means of protecting them was necessary. A 2-foot covering of mud, to be obtained from the marsh in rear of the battery, was decided upon as the cheapest way of doing this.

Experiments with the object of determining the best method of applying this covering were put under my charge. There was no information at hand relative to the method to be employed or to the probable cost.

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The contractors for the sand in the parapets had on hand much of the plant necessary for the prosecution of the work, and they agreed to make a six-day experiment under the direction of the engineer officer in charge, and at the end of that time to submit a bid for the work. All facilities were to be afforded the representative of the United States to get at the actual cost of the work to the contractors, in order that he might determine if the bid submitted was advantageous to the United States. During the continuation of these experiments, made under my direction, I made careful record of the force employed and the amount of mud deposited. The estimate of cost, upon which the final decision as to the acceptability of the bid rested, was based upon the amount of mud it was believed could be deposited on the slopes by the necessary force properly organized. The force employed was under the organization selected by the contractors, and it was noted if any superfluous laborers were employed. The method to be employed was selected by me.

Two difficulties were anticipated—one, that the mud would roll about itself a ball of sand and to go to the bottom of the slope, and the other that the mud would not slide on the sand and thus require hand distribution. Both these fears proved to be groundless. The sand contractors, who feared the latter difficulty, had provided a chute in sections, so that the mud might slide down and when the lower portion of the slope had received its covering the lower section of the chute could be removed and the next succeeding part then receive its covering. The mud when dumped on this chute descended rapidly to the bottom of the slope, where it had acquired such velocity that it went out some distance from the foot of the slope on the reservation. The lower section of the chute was taken up, but the mud slid down, leaving a thin skin of mud over the sand, over which the mud descended quite as rapidly as before. All the sections were then removed, but to no purpose. It was seen from this that some means of stopping the mud on the slope and holding it there was necessary. The first plan was to put in position the posts for three barricades, this being thought to be a sufficient number. The boards for that farthest down the slope were put in position, and it was intended when this barricade had filled with mud to put in the boards of the next, and so on, each being of sufficient height to hold enough mud to cover the part of the slope between it and the next above. When the mud was dumped at the top of the slope, it slid rapidly down as before and carried away the lower barricade, although it was quite strongly built. Then all three barricades were put in position, and by stopping the mud before it acquired much velocity all were able to hold against the weight of the mud, and each was filled from the overflow of that next above. This was the plan that was followed throughout, and it was entirely satisfactory.

After the termination of the experiment the sand contractors submitted a bid of 30 cents a cubic yard for mud in place, including the cost of the barricades and putting them up and the trestle leading from the marsh to the top of the parapet. The former were to remain in place after the mud work was finished, and the latter was to be removed from the reservation upon the completion of the work. This was believed to be cheaper than the United States could hire the plant and do the work, so the contract was awarded to the sand contractors. This contract called for the construction of three barricades on the slopes. They were to be built normal to the slope, of 2-inch plank supported in the middle and at each end by 4 by 4 inch posts set in the sand at least 5½ feet, suitably braced in such manner as the contractor might select. Tie strips, leading from the top of the posts to the bottom of the corresponding post in the barricade next above, were suggested to them as the most suitable way, but they preferred to brace by means of struts from below, as they could thus utilize many of the cross-ties that had been used in the track for the sand work. These were also used for posts in the barricades. It is important to note that the barricades must be built normal to the slopes, as otherwise the mud will lift the barricades and flow through under them.

On the steeper slopes three barricades were not sufficient, and six were built. The mud covering on the parts where the greater number of barricades were used was much more satisfactory than on the other portions, and it is believed that it would have been better to have used four barricades on all the gentler slopes.

At first much difficulty was experienced in filling the cars with mud by the dredge owned by the United States. This is of the clam-shell pattern, and with all the care that could be exercised the cars would dump in filling. A low, flat hopper had to be built to overcome this tendency. Stay chains had also to be used.

The average amount of mud deposited per day, the force employed, and the arrangement of the plant used were all very closely what had been used as a basis for the decision upon the bid of the contractor.

Respectfully submitted.

EDWIN R. STUART,
Additional Second Lieutenant Engineers.

Capt. FREDERIC V. ABBOT,
Corps of Engineers, U. S. A.

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UNITED STATES ENGINEER OFFICE,
Charleston, S. C., June 30, 1897.

CAPTAIN: I have the honor to submit the following report on the mounting of 12-inch mortars at the battery during the fiscal year ending June 30, 1897:

It is believed that the methods here adopted were such as deserve to be properly recorded. The mounting was performed under the supervision of Mr. Michael Derrenbacher, who devised the methods used, as instructions for mounting the mortars were not issued until after the work had been done. The mortars and their carriages were delivered at the site by the Quartermaster's Department, the transportation from the city to the site being done under contract calling for delivery of ordnance material near the pits where it was to be mounted. For convenience in transporting the material from the wharf in rear of the mortar battery to the place designated for the final delivery the contractor mounted all the heavier pieces on cradles made of 12 by 12 inch timbers parallel to each other, held together by two pieces of suitable dimensions spiked to them. The cradles for the mortars and the sidepieces of the carriages had crosspieces for them to rest on. Those for the mortars were arranged so that the mortars rested with their axes parallel to the ground. All the material was hauled from the wharf to the site over roller ways prepared by laying heavy planks in the sand. Block and tackle furnished suitable power for the hauling, being operated by man power.

The process of mounting the heavier pieces was as follows:

Base rings.—A roller way of two 12 by 12 inch timbers was prepared, its upper surface at the final position of the base ring being 2 or 3 inches lower than the lower edge of the base ring when at its final level. Up this inclined way the ring was hauled by means of block and watch tackle. Having been placed in approximate position, it was supported on jacks, four 6-ton screw jacks being used, and the rollers and cradle removed. It was then lowered, the jacks being turned simultaneously. Blocking was always kept within an inch of the under edge to prevent accident in case of failure of a jack. This precaution was observed in the handling of all the heavier pieces. The base ring was then placed in its final position. In doing this use was made of the center of the ring, marked on a piece of timber wedged firmly on approximately a diameter of the ring. The anchor bolts were hung and the concrete brought up around them to within about 2 feet of the lower edge of the base ring and allowed to set. Then the ring was jacked up, using four 6-ton jacks, and the Portland concrete foundation ring was put in. The base ring was lowered. Six of the anchor bolts were provided with double nuts and were threaded a sufficient length to permit these being used as leveling screws, and the base rings were accurately leveled. The foundation was completed by driving between the upper surface of the Portland concrete ring and the bottom of the base ring a layer about an inch thick of Portland cement mortar. When it was discovered that the settlement of the battery had thrown the platforms out of level, this last thin layer of mortar was not driven, and the base rings were left supported on the leveling nuts. The rollers and spider were then put in place.

Racers.—The racers are brought up to a position over the base rings over similar inclined ways by the same means. When in position, they are jacked up by four 6-ton screw jacks and the roller ways removed. With blocking for safety as before, the racers are lowered till their lower edges pass the upper surface of the base ring. When nearing this position, lateral motion necessary to make it go down over the base ring, having, as it does, only about one-tenth of an inch clearance, is produced by setting a jack in an inclined position against the side, supporting the racer free from the blocking on screw jacks, and then forcing in the desired direction. This process throws the supporting jacks slightly out of the vertical, and the racer is lowered on the blocking and the jacks again set vertical.

Sidepieces.—The vertical brace of the shaft of the traversing wheel is first put in position. Preparatory to mounting the sidepieces it is important to lock the racer to prevent its rotation and consequent accident. This is done by setting a jack on either side of the lower part of the spring cylinder-recess and inclined to the vertical about 45°. The sidepieces are brought up the inclined ways, their inner sides up, and put in such a position that in revolving to a vertical position the lower end of the spring cylinder will descend into the opening in the top of the racer. It is then lifted by jacks, the rollers and cradle removed, when it is supported at the top and lowered at the bottom, giving it a considerable inclination. This is increased by still further jacking and blocking up the upper part. The lower edge is lowered till it rests on two 3 by 10 inch planks, secured in position by pins driven in bolt holes in racer. By block and fall attached to top of sidepiece it is then raised to a vertical position, a guy being used to insure its not going beyond the vertical. It is now moved sidewise by pries. The planks are removed, the cheek being supported by a jack under each end of two crowbars put through bolt holes in front and the rear being supported by a jack under the spring cylinder. It can thus be lowered on

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the racer. A piece of inch plank left under the front end makes subsequent lateral motion easier. This lateral motion is produced by a jack in rear bearing against the rib under the loading scoop, and in front by one bearing against a stud bolt screwed in one of the transom bolt holes. When nearly in position, it is lowered flat on the racer and final motion produced by ramming with a piece of 8 by 8 inch timber.

Guns.—Mortars are mounted breech foremost over the transom. If necessary to turn them around before starting up the inclined roller way, this can be done by balancing on one roller and pulling the end by block and tackle. Changes of direction are easily effected by knocking one end of one of the supporting rollers in the proper direction.

When the carriage is reached, a piece of 12 by 12 inch timber, 6 or 8 feet long, with one end rounded, is inserted in the bore of the piece. Eight by 8 inch timbers across the carriage, between the cheeks, furnish the support for roller way for a hydraulic jack placed under the 12 by 12 inch timbers in the breech of the piece. The breech is raised by the hydraulic jack and crosspieces of cradle removed, the lower 12 by 12 inch timbers of the cradle forming now the roller way. The muzzle of the piece is pried up by a long 3-inch plank pry and the front crosspiece of the cradle removed and rollers inserted. The mortar thus rests on rollers at the muzzle and on a hydraulic jack (itself on a roller way) at the breech. It is then pulled in till trunnions are near trunnion ways, when it is jacked up and the trunnions started in the trunnion ways. By alternate lowering of muzzle and breech, the trunnions come to a bearing in the trunnion beds. Small one-half-inch iron strips with flattened ends keep the trunnions from catching on or injuring the corners of the brass trunnion beds.

Respectfully submitted.

EDWIN R. STUART,
Additional Second Lieutenant Engineers.

Capt. FREDERIC V. ABBOT,
Corps of Engineers, U. S. A.

TEN-INCH BATTERY.

History.—An allotment of $500 from the appropriation for "Gun and Mortar Batteries," act of June 6, 1896, was made on August 31, 1896, for the purpose of making the necessary plans and drawings for four emplacements for 10-inch rifles on disappearing carriages. It was proposed to actually construct at that time only two emplacements.

The plans and drawings having been prepared and approved, an allotment of $9,500 was made on December 11, 1896, from the same act and appropriation. This was for the purpose of supervising the actual construction, which was to be by continuing contract. On March 26, 1897, an allotment of $150,000 was made from the same appropriation contained in the act of March 3, 1897. This was to be applied exclusively to payments under the contracts.

Foundations.—Carefully conducted borings showed that at the site originally selected by The Board of Engineers one-half of the battery would be founded on a layer of sand not less than 40 feet thick, but that the eastern half would rest on a thick pocket of soft mud, very similar to that found beneath the mortar battery. Permission was asked and given to shift the whole battery about 400 feet west, where a foundation of uniform sand 40 feet thick under the whole battery was found.

Planes of weakness.—To provide against the ill effects of settlement, should any occur, the battery was divided up into pieces about 40 feet long by vertical planes, so selected as to never cut through any of the numerous steel beams used in roof work. The foundation has so far given no trouble, and the many parts of the massive concrete walls, 30 feet thick, which have been completed up to their full height for nearly two months, show settlement never exceeding .05 of a foot.

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Specifications and use of Government plant.—Specifications were prepared and bids opened on November 30, 1896. The contract was awarded to the lowest bidders, Messrs. Jacob Friday & Sons, who had formerly been members of the contracting firm of Egan & Friday, and in this capacity had completed the continuing contract for the Charleston jetties. Their previous experience here was of great advantage to the work, and but little time was lost in preliminaries.

By the specifications they were required to rent and use the plant which the United States had provided for the mortar battery. The sum of $1,550 a month was charged for this plant, which comprised the following items:

A complete quarry plant and stone crusher, with elevated bins and screens; a good tug and 8 good 200-ton scows; a good steam-derrick scow; a good concrete mixing plant, with three good double-drum, double-cylinder hoisting engines of about 20 horsepower each; a good steam pile-driver for use on land; 1,400 feet of Hunt portable railroad track, with steel ties, and curves, switches, and a number of Hunt tip cars and flat cars. With the plant a quantity of steel wire rope, guy lines, manila rope, and other supplies and attachments, and a number of shovels, wheelbarrows, rammers, etc., were supplied by the Government.

The prices offered under this arrangement were about the same as those bid elsewhere on the Atlantic Coast in the vicinity where the Government had no plant. As the battery will require about ten months for its construction, the plant will save about $15,000. In two other aspects the possession of the plant has been beneficial. First, as there was no extensive plant to be accumulated, work began at once; second, the rent is a self-applying bonus for rapid work and penalty for delay. The contractors fully appreciate that every day saved in completing their contract means a saving to them of $50 in rent, and this in no small measure accounts for the activity with which they have prosecuted the work.

The contract was approved January 21, 1897, but work on the plant had begun on January 1, 1897. The actual construction of the battery began between March 1 and March 10 with work on the concrete sea wall. Since that time the rate of progress has been steadily increasing, and now averages about 180 cubic yards of concrete in place, including large stone, per day of eight hours. That this rate was attained with a single 4-foot cube mixer is due to the well-considered arrangement of plant adopted.

Arrangement of plant.—The site of the battery is about 1 mile distant from the nearest wharf on the island at which loaded lighters can lie. A railroad was thus a necessity. A right of way through the streets of Moultrieville was secured from the town council. On the decks of two of the Government lighters railroad tracks were laid so that 40 of the narrow gauge cars can be put afloat. They are loaded at the railroad wharf in Charleston and towed to the island. There the lighter is put into a suitable slip and the loaded cars are hauled up an adjustable incline by a steel-wire rope, operated by a double-cylinder, 4-drum hoisting engine on the wharf. This same engine operates a derrick used to unload all other material and deposit it on cars running on suitable tracks on the wharf. From the wharf the railroad is single track as far as the scale-house, which is situated a short distance from the western end of the battery. From this point tracks radiate as follows:

One runs entirely through the cement shed, which is situated near

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the western end of the battery and has its length parallel to the back of the battery.

The second track runs to the foot of an incline leading to the top of the bins for storing sand and broken stone.

A third track runs directly in rear of the battery, serving also as a part of the track on which one of the traveling cranes runs.

Others lead to convenient points of delivery.

As cement is delivered in schooner-load lots, a cement warehouse of 7,000 barrels capacity was provided.

The bins for sand and stone are between the cement warehouse and the battery. They form two parallel V-shaped troughs touching at the top, the inclination of all the bottom planes being one on one, and the divisions into pockets being made by vertical planes. The center of the narrow-gauge railroad track is over the intersection of the planes forming the inner sides of the two troughs. When the cars are dumped the contents are thus about equally divided between the two troughs, no hand distribution being required. At the bottoms of the pockets there are a number of iron sliding doors. When they are open the materials drop into the Hunt tip cars which carry them to the mixer.

A loop of Hunt track runs under the bins, and the tip cars run west on the south track and east on the north. As they pass around the curve at the west end of the bins they are run out on a short spur and receive the charge of cement. By this arrangement there is no confusion of cars meeting and passing, and as many can be put in service as the needs of the moment may dictate. The two ends of the loop at the east come together into a single track where the cars go up a vertical elevator close to the mixer. In this way the latter can be kept fed constantly, and never stops from the beginning of the eight hours till the end, except to be emptied and refilled. The capacity of the mixer is the one limiting factor in a concrete plant. Everywhere else extra cars or labor will accelerate progress, and this is where the plant at this battery is so well arranged. No time being lost by the mixer, the maximum speed is attained.

From the mixer the concrete is carried in 1-yard dump buckets, riding on flat cars, to the point of deposit. The buckets are lifted off the cars by two steam cranes. One of these was a regular traveling crane revolved by steam. The other was a stiff-legged derrick, mounted on a heavy platform, supported on eight pairs of the same wheels and axles that were used on the narrow-gauge cars. The crane ran on a pair of parallel narrow-gauge tracks laid about 15 feet from center to center. This crane is revolved by ropes attached to the boom and operated by the spoolheads on an ordinary hoisting engine. On its drums are the steel-wire ropes constituting the falls and topping lift. This crane is moved along the track by a rope attached to ties at suitable points and operated by the spool heads. While not so efficient as the regular crane, this machine has done good and rapid work.

The regular crane runs on a track parallel to that of the other crane, and between the sea wall and the main wall of the battery. Every point at which concrete is to be deposited is thus in reach of one or other of the cranes, and the heaviest walls can be reached by both.

Material for the parapet is taken from the sand hills in the vicinity. It is carried up over the eastern flank of the sea wall in cars pulled up an inclined trestle by a hoisting engine on top of the concrete wall in front of the magazine for the eastern gun. The sand cars are thence pushed along a track laid on top of the finished concrete and are

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dumped into the space between the sea wall and the main wall of the battery.

No work of actual construction is done at night. The supply trains run from daylight till midnight under ordinary circumstances and during the whole twenty-four hours while delivering cement.

The cement comes from New York in schooners; the steel beams from Pittsburg by rail. The contractors deserve credit for having so far prosecuted the work without any delay on account of failure to receive either of these materials on time, or of stone which comes from Edgefield and Columbia by rail. The iron stairways and shot-lift mechanism are made in Charleston.

PROGRESS OF WORK.

December 31, 1896: Contracts signed and awaiting approval of the Chief of Engineers.

January 31, 1897: Contracts approved. Railroad, cement shed, stone bins, and slip at wharf in process of construction.

February 28, 1897: At work on plant.

March 31, 1897: Plant complete. Two hundred linear feet of sea wall completed; some casing up for main walls. Concrete deposited during the month, 1,121 cubic yards.

April 30, 1897: Two hundred and forty additional linear feet of sea wall completed. Concrete deposited in sea and main walls during the month, 3,622 cubic yards.

May 31, 1897: Concrete work about half finished; incline for parapet filling completed. Concrete deposited during the month, 4,648 cubic yards. Working days during the month, 25. Average amount of concrete deposited per day of eight hours, 185.92 cubic yards.

June 30, 1897: Concrete work six-tenths completed; sand filling one-tenth completed; shot lifts in position.

By April 10, 1897, the battery had reached a stage where it was evident that the base rings for the three 10-inch guns would be soon needed. On that date application was made for the base rings and guns, as they could be handled to great advantage together. The suggestion was also made that it was very desirable to complete the fourth and last gun emplacement if funds could be allotted. On the 21st information was received that the guns and carriages would be shipped for three emplacements some time in August, and that the fourth emplacement would be authorized if funds were available later in the year.

The project for this battery included an artesian well, as there is no drinking water supply on the island beyond rain water caught in cisterns. The contract for the same was awarded to Mr. E. F. Joyce, of St. Augustine, Fla., the contract being approved on December 26, 1896.

In this vicinity there are three artesian strata. The first lies at a depth of between 400 and 500 feet. The water is generally heavily charged with carbonate of soda and is not potable. At a depth of between 1,200 and 1,300 feet there is a layer of water-bearing rock which gives a small flow of water of exceptional purity. At a depth of little over 2,000 feet a plentiful supply of good drinking water is found. The contract was so worded as to permit the United States to stop work at either of the two higher levels, depending upon the volume and quality of water found at the 400-foot level.

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PROGRESS OF WORK.

December 31, 1896: Contract approved.

January 31, 1897: Plant in place and 12-inch casing down 50 feet.

February 28, 1897: Twelve-inch casing down 58 feet; 10-inch casing down 110 feet; drilling down 200 feet.

March 31, 1897. Ten-inch casing down 235 feet. Drilling down 350 feet.

April 30, 1897: Eight-inch casing down 397 feet. Drilling, 410 feet. Waiting on additional 8-inch casing. New engine and boiler received at Charleston.

May 31, 1897: New engine and boiler at work during the month. Eight-inch casing driven to 406 feet 9 inches, where it stopped in very hard rock. Drilling continued to 700 feet, when it was stopped, awaiting 6-inch casing, as the hole caved so badly that drilling could not be continued without casing.

June 30, 1897: The 6-inch casing was down to a depth of 765 feet.

When the 400-foot stratum of water-bearing rock was penetrated, there was not sufficient head to flow, and the water was not potable. At Fort Sumter this stratum gave a flow, but the water was not palatable, although perhaps potable.

Much delay has resulted from the failure of the contractor to install a proper plant at the beginning, and to keep a sufficient supply of casing on hand.

Money statements.

PLANS FOR 10-INCH RIFLE EMPLACEMENTS.

August 31, 1896, amount allotted	$500.00
June 30, 1897, amount expended during fiscal year	500.00

SALARIES AND OFFICE EXPENSES.

December 11, 1896, amount allotted		$9,500.00
June 30, 1897, amount expended during fiscal year		3,629.01
July 1, 1897, balance unexpended		5,870.99
July 1, 1897, outstanding liabilities		825.00
July 1, 1897, balance available		5,045.99

PAYMENTS UNDER CONTRACTS.

March 26, 1897, amount allotted		$150,000.00
June 30, 1897, amount expended during fiscal year		55,971.23
July 1, 1897, balance unexpended		94,028.77
July 1, 1897, outstanding liabilities	$33,621.27	
July 1, 1897, amount covered by uncompleted contracts	91,422.53	
		125,043.80

Amounts and dates of all allotments for this battery.

Date of act.	Date of allotment.	Amount.	Remarks.
June 6, 1896	Aug. 31, 1896	$500	Plans and drawings.
Do	Dec. 1, 1896	9,500	Supervision.
March 3, 1897	Mar. 26, 1897	150,000	Contract payments.

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Abstracts of proposals for furnishing material and constructing two emplacements for 10-inch rifle battery, received in response to advertisement dated Charleston, S. C., October 29, 1896, and opened November 30, 1896, by Capt. Frederic V. Abbot, Corps of Engineers.

	John L. Grim.	Geo. W. Egan.	Jacob Friday & Sons.	Earle Sloan and Hasell W. Crouch.	Stewart Contracting Co.	Gude & Walker.	A. M. Manigault and Rutledge Holmes.
Large stone...per short ton..	$2.60	$2.90	$2.50	$5.55	$3.05	$2.35	$2.30
Broken stone.....do....	2.80	2.95	2.50	5.35	3.31	2.45	2.25
Pon Pon gravel ..per cu. yd..	.90	1.13	1.35	1.20	1.06	1.10	.75
Sand-hill sand in bins..do....	.30	.35	.35	.25	.40	.30	.25
American Portland cement, per barrel.....	2.40	2.60	2.35	2.70	2.66	3.00	3.25
American natural cement, per barrel.....	1.15	1.24	1.05	1.25	1.18	1.35	1.55
32 anchor bolts...for the lot..	750.00	225.00	150.00	180.00	270.00	300.00	200.00
Steel I-beams..per long ton..	67.20	55.00	52.00	44.80	58.00	60.00	37.10
Corrugated iron..per 100 lbs..	4.50	5.00	3.50	3.00	4.68	4.00	3.33
Cast-iron drain cover, per linear foot.....	.75	.80	.75	.75	.85	.80	.68
Iron stairways:							
3 feet wide.....per step..	8.25	12.00	10.35	10.35	14.79	11.00	9.65
4 feet wide.....do....	8.50	13.50	12.15	12.00	17.38	12.00	10.70
4.5 feet wide.....do....	9.00	14.00	13.05	12.25	18.75	13.00	13.40
6 feet wide.....do....	12.50	18.00	15.15	18.60	25.19	15.00	14.70
Iron ladder...per linear foot..	1.25	1.25	1.25	1.10	.82	1.00	1.00
Small doors and hinges, per doorway.....	50.00	40.50	55.00	30.75	55.00	75.00	25.00
Large doors and hinges, per doorway	70.00	50.00	80.00	33.00	70.00	85.00	25.00
Brass pipe.....per pound..	.40	.20	.20	.15	.50	.20	.17
Trolley system...for the lot..	950.00	700.00	365.00	600.00	2,000.00	400.00	400.00
Concrete mixing, in place, per cubic yard.....	1.65	1.43	1.60	4.35	1.17	1.40	3.05
Setting base rings..per gun..	55.00	200.00	200.00	100.00	300.00	100.00	100.00
Sand embankment, in place, per cubic yard	.25	.25	.25	.20	.30	.20	.15
Excavation, in place, per cubic yard.....	.25	.25	.25	.20	.25	.18	.15
Fertile earth, in place, per cubic yard.....	1.00	1.20	1.00	1.25	1.25	1.25	.90
Total amount of bid....	116,635.02	119,906.70	110,813.56	209,655.03	123,175.25	110,931.04	132,179.04

Abstracts of proposals for boring an artesian well received in response to advertisement dated Charleston, S. C., October 29, 1896, and opened November 30, 1896, by Capt. Frederic V. Abbot, Corps of Engineers.

Name of bidder.	Well 500 feet deep.	Well 1,300 feet deep.
W. H. Gray & Bro.	$4,000.00	$10,300.00
Morris Drilling Co.	2,650.00	7,580.00
Chapman Bros.	3,300.00	13,900.00
E. F. Joyce	3,120.00	6,295.50

List of contracts in force.

Contract for—	Name of contractor.	Date of approval.	Date of beginning.	Date of completion.
Constructing 3 emplacements for 10-inch guns.	Jacob Friday & Sons...	Jan. 21, 1897	Feb. 1, 1897	Dec. 1, 1897
Boring artesian well.....	E. F. Joyce.....	Dec. 26, 1896	Jan. 14, 1897	Dec. 1, 1897

Sites.—At the close of the last fiscal year twenty-one lots had been purchased, at an aggregate cost of $31,232. The above lots formed the entire site for a mortar battery, and parts of sites for a 10-inch and a 12-inch rifle battery.

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During the past twelve months all the lots required to complete these sites were purchased at the original appraised value, or by amicable compromise, except seven. During the month of March condemnation proceedings were instituted and the following verdicts were obtained:

Lot.	Owner.	Date of verdict.	Amount.
U & V.	Mrs. M. A. Gilchrist	Mar. 19, 1897	$1,200.00
226	Mr. J. V. McNamee	Mar. 25, 1897	695.50
240	Dr. A. W. Eckel	do	1,400.00
241	Mr. C. M. Drake	do	1,600.00
242	Mrs. Mary L. Allison Holton	Mar. 26, 1897	1,020.00
256	Mrs. Johanna Michaelis	do	1,100.00
105	Mrs. Pauline S. Heyward	do	6,437.50
	Total of verdicts		13,453.00

In connection with these proceedings, the papers which were originally submitted to the Attorney-General of the United States were returned for further report and supplementary papers which were supplied by the United States district attorney for South Carolina. The amended papers for lots 105, 240, and 256 were returned to this office with the approval of the Attorney-General of the United States, and payment has been made. At the time of payment a claim was made in each case for interest at 7 per cent per annum, the legal rate in South Carolina. This was resisted by the district attorney, and settlement was finally made for the amount of the verdicts.

At the close of the year the United States had clear title to the site for the 10-inch battery and the mortar battery, and only four lots remain to be acquired to complete the site for the 12-inch battery.

Money statement.

July 1, 1896, balance unexpended		$10,990.10
Amount allotted December 14, 1896, act June 6, 1896		3,782.36
Amount allotted April 14, 1897, act June 6, 1896		13,000.00
		27,772.46
June 30, 1897, amount expended during fiscal year		21,129.11
July 1, 1897, balance unexpended		6,643.35
July 1, 1897, outstanding liabilities		4,515.50
July 1, 1897, balance available		2,127.85

Amounts and dates of all allotments for this purpose.

Date of allotment.	Date of act.	Amount allotted.	Purpose.
March 22, 1895	Aug. 18, 1890	$3.89	Appraisement.
March 22, 1895	Feb. 18, 1893	440.03	Do.
March 22, 1895	Aug. 1, 1894	56.08	Do.
July 29, 1895	do	42,072.10	Purchases.
December 17, 1895	do	150.00	Do.
December 14, 1895	June 6, 1896	3,782.36	Do.
April 14, 1897	do	13,000.00	Do.
Total		59,504.46	

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3 M.

DEFENSES OF COAST OF GEORGIA AND CUMBERLAND SOUND.

Officer in charge, Capt. O. M. Carter, Corps of Engineers; Division Engineer, Col. P. C. Hains, Corps of Engineers.

Three emplacements for 8-inch rifles, disappearing carriages.—Plans and specifications for this work have been completed during the fiscal year and were approved by the Department. The contract for the construction of the work was awarded November 30, 1896, to the Venable Construction Company, of Atlanta, Ga., and work was commenced by them on February 10. The work done up to the end of the fiscal year consisted in erecting a house for the use of the Government employees, in clearing and grubbing the site, in putting up the working plant, and in excavating 2,864 cubic yards of material.

Plans and specifications for a wharf and a railroad connecting the same with the emplacements were made, and were approved by the Department. The contract for the construction of a wharf and railroad was awarded, on December 19, to P. Sanford Ross, of Jersey City, N. J.; work was commenced on February 22 and completed on May 31.

The wharf is 391 feet long and 20 feet wide, and at its outer end a wing 30 feet square is added on each side, so that a hammer-shaped pierhead is formed, with a water front 80 feet long. Bents were 10 feet apart, and are formed of 7 piles each, viz, one pile under each rail of the double track carried by the pier and extending to its outer end, one pile between the two tracks, and a batter pile on each side of the pier, firmly connected by hooks and bolts with the outside bearing pile and serving as bracing, no other bracing being employed in the pier. At the shore end of the wharf the double track merges into a single track, which is carried on a trestle for a distance of 1,169 feet until high ground is reached, and thence continues on the ground for 1,630 feet to the fort and along its entire length in its rear. Suitable switches are provided at the fort and on the wharf, and two pairs of boat davits are mounted on the pierhead. Submerged parts of the piles in the wharf have been covered according to the Gallinowsky process, to protect them against the teredo. This process consists in wrapping the piles with several thicknesses of a textile fabric saturated with a peculiar kind of cement. A crust of about one-fourth inch thick is thus formed, which becomes very hard. The piles in the wharf, as well as the trestle, were sunk by means of the water jet. Bifurcated 1¼-inch pipes were used, one end on each side of the pile. All iron work used in the construction of the wharf was galvanized. In the construction of the wharf, the trestle, and the railroad the following material was used:

10,951.5 linear feet protected piles.
5,409 linear feet unprotected piles.
44,598.45 pounds galvanized iron.
23,015.50 pounds black iron.
198,427 feet B. M. sawed timber.
2 boat davits.
7,140.60 cubic yards of excavation.
902 hewn crossties.
49 tons of steel rails, weighing 40 pounds per linear yard.
7,500 pounds fish plates, bolts, etc.
4 switches.

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Money statement.

PLANS, SUPERINTENDENCE, ETC.

Amount allotted	$10,000.00
June 30, 1897, amount expended during fiscal year	4,699.33
July 1, 1897, balance unexpended	5,300.67
July 1, 1897, outstanding liabilities	708.95
July 1, 1897, balance available	4,591.72

CONTRACT.

Amount allotted		$145,000.00
June 30, 1897, amount expended during fiscal year		19,342.27
July 1, 1897, balance unexpended		125,657.73
July 1, 1897, outstanding liabilities	$206.89	
July 1, 1897, amount covered by uncompleted contracts	125,450.84	
		125,657.73

List of contracts in force.

Name and address of contractor.	Character of work.	Date of approval of contract.	Work began.	Contract expires.
Venable Construction Co., Atlanta, Ga.	Gun emplacements	Jan. 18, 1897	Apr. 21, 1897	Dec. 31, 1897

Abstracts of bids opened at Savannah, Ga., on December 10, 1896, by Capt. O. M. Carter, Corps of Engineers, for building a wharf and railway.

Items.	No. 1.—C. W. Jacobson & Co., Savannah, Ga.		No. 2.—B. F. Kramer, Charleston, S. C.		No. 3.—P. Sanford Ross,* Jersey City, N. J.	
	Price.	Amount.	Price.	Amount.	Price.	Amount.
Excavation, etc. (8,000 cubic yards), per cubic yard, in place	$0.20	$1,600.00	$0.40	$3,200.00	$0.17 9/10	$1,432.00
Hewn cross-ties (1,000), each, in place	.60	600.00	.60	600.00	.63½	635.00
Piles:						
Protected (12,000 linear feet), per linear foot	.63	7,560.00	.50	6,000.00	.41	4,920.00
Unprotected (2,600 linear feet), in place	.28	728.00	.20	520.00	.33⅓	871.00
Sawn timber and lumber (150,000 feet B. M.), per 1,000 feet, in place	27.50	4,125.00	40.00	6,000.00	23.13	3,469.50
Steel rails (47 tons), per ton, in place	105.00	4,935.00	50.00	2,350.00	48.26	2,268.22
Angle bars, bolts, spikes, etc., for track (12,500 pounds), per pound, in place	.10	1,250.00	.04	500.00	.02½	312.50
Split switches (5), each, in place	50.00	250.00	50.00	250.00	25.00	125.00
Galvanized-iron bolts, straps, wire spikes, etc. (15,000 pounds), per pound, in place	.10	1,500.00	.10	1,500.00	.06 4/10	960.00
Iron bolts, straps, wire spikes, etc. (7,000 pounds) per pound, in place	.10	700.00	.04	280.00	.02½	175.00
Galvanized-iron boat davits (2 pair), per pair, in place	100.00	200.00	50.00	100.00	96.75	193.50
Total		23,448.00		21,300.00		15,361.72

Amount available, nothing.

* Bid recommended for acceptance, he being the lowest responsible bidder for the most satisfactory materials and service.

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Abstracts of proposals for gun emplacements, opened by Capt. O. M. Carter, Corps of Engineers, at Savannah, Ga., November 16, 1896.

Items.	No. 1.—Gude & Walker, Atlanta, Ga.		No. 2.—John L. Grim, Philadelphia, Pa.		No. 3.—Stewart Contracting Co., Columbia, S. C.		No. 4.—Venable Construction Co.,* Atlanta, Ga.	
	Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.
Excavation (15,000 cubic yards) per cubic yard	$0.17	$2,550.00	$0.45	$6,750.00	$0.23	$3,450.00	$0.18	$2,700.00
Fill (2,000 cubic yards), per cubic yard	.17	340.00	.60	1,200.00	.25	500.00	.20	400.00
Brick (38,000), per M	30.00	1,140.00	32.00	1,216.00	19.00	722.00	25.00	950.00
Concrete:								
No. 1 (2,730 cubic yards), per cubic yard	8.59	23,450.70	8.40	22,932.00	7.98	21,785.40	6.50	17,745.00
No. 2 (14,000 cubic yards), per cubic yard	6.27	87,780.00	6.40	89,600.00	5.96	83,440.00	5.83	81,620.00
No. 3 (400 cubic yards), per cubic yard	10.62	4,248.00	11.70	4,680.00	12.07	4,828.00	9.25	3,700.00
Rubble (1,000 cubic yards) per cubic yard	5.65	5,650.00	5.50	5,500.00	5.33	5,330.00	3.75	3,750.00
Cut stone (80 cubic yards), per cubic yard	68.00	6,440.00	55.00	4,400.00	68.19	5,455.20	27.00	2,160.00
Iron pipe (8,000 pounds), per pound	.05¾	460.00	.02	160.00	.07	560.00	.05	400.00
Earthen pipe:								
4-inch (200 linear feet), per linear foot	.29	58.00	.30	60.00	.10	20.00	.10	20.00
18-inch (1,000 linear feet), per linear foot	1.15	1,150.00	1.66	1,660.00	.50	500.00	.50	500.00
Steel beams (80,000 pounds), per pound	.02 8/10	2,080.00	.02⅞	2,300.00	.03	2,400.00	.05	4,000.00
Bolts, plates, and nuts (17,000 pounds), per pound	.06	1,020.00	.03¾	637.50	.07	1,190.00	.08	1,360.00
Ladders and hand rails (3,300 pounds), per pound	.11½	379.50	.18	594.00	.10	330.00	.07	231.00
Trolleys and trolley beams (10,000 pounds), per pound	.08½	850.00	.15	1,500.00	.11	1,100.00	.10	1,000.00
Cranes (No. 8), each	170.00	1,360.00	473.00	3,784.00	275.00	2,200.00	220.00	1,760.00
Ammunition lifts (pairs 8), per pair	565.00	4,520.00	880.00	7,040.00	500.00	4,000.00	450.00	3,600.00
Doors:								
Lumber (2,700 feet B. M.), per linear foot	.11	297.00	.08	216.00	.15	405.00	.15	405.00
Metal work (2,700 pounds), per pound	.34	918.00	.70	1,890.00	1.00	2,700.00	.20	540.00
Pine stripe (1,000 feet B. M.), per linear foot	.11	110.00	.07	70.00	.15	150.00	.02	20.00
Total	.....	143,801.20	.....	156,189.50	.....	141,065.60	.....	126,861.00

Amount available, nothing.

*It is recommended that the bid of the Venable Construction Company, of Atlanta, Ga., William H. Venable, president, be accepted, that company being the lowest responsible bidder for the best and most suitable material and service.

Amount available, nothing.

NOTE.—The proposal of the Venable Construction Company is not attested by the secretary of the company; it does not bear the impression of the seal of the company, and there is not filed with it any evidence that the president of the company is authorized to bid on the work or enter into contracts. No bidder delivered any sample barrels of cement; John L. Grim and Stewart Contracting Company failed to deliver samples of stone, and only the Venable Construction Company delivered samples of sand.

3 N.

DEFENSES OF COAST OF FLORIDA.

Officer in charge, Lieut. Col. W. H. H. Benyaurd, Corps of Engineers; assistants, Lieut. J. J. Meyler, Corps of Engineers, to February 19, 1897, and Lieut. R. P. Johnston, Corps of Engineers, since September 15, 1896.

Fort Marion, St. Augustine, Fla.—For a brief historical sketch of this work, which was built during the Spanish possession and finished in 1756, attention is invited to annual report of engineer in charge for 1889. It is not available for defense, but is worthy of preservation as an object of historical interest.

One 8-inch converted rifle is mounted and is used by the artillery troops at St. Francis Barracks for target practice.

At the beginning of the year $150 was available for placing the platform of this gun, which had become damaged during target practice,

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in a serviceable condition. New stones for traverse circle were cut and steps taken to remedy settlement of platform, when it was found that the subfoundation was of an unstable nature. To remedy this, an additional allotment was necessary; therefore $215 additional was made available on August 21, 1896.

The work was completed in November, the full amount available being expended therefor.

Money statement.

July 1, 1896, balance unexpended	$150.00
August 21, 1896, amount allotted	215.00
June 30, 1897, amount expended during fiscal year	365.00

Key West, Fla.—At the beginning of the year the project of The Board of Engineers for the artillery defense of this point was under consideration, having in view the construction of emplacements for modern guns and mortars. The work under way during the year was the preparation of plans and the commencement of construction, by contract, of a gun battery and a mortar battery; the preparation of plans and the construction, by hired labor, of a mining casemate and cable gallery, and negotiations for the acquirement of sites.

The construction of the mining casemate was under the immediate charge of Lieut. R. P. Johnston, Corps of Engineers, as was also the immediate supervision of the contractors' work on the gun and mortar batteries, and to him is due credit for great interest and zeal in the execution of these works and for the results so far obtained.

Gun and mortar batteries.—The gun battery contains emplacements for four 10-inch guns on disappearing carriages, model 1896, and two 8-inch guns on disappearing carriages, model 1894; the mortar battery contains eight 12-inch rifled mortars. It was at first intended to construct a battery of 16 mortars, but on account of the cost and the small amount of funds that could be allotted the number of mortars was reduced to 8 and the battery so designed as to permit enlargement to the original number at any time.

Plans and specifications for these two batteries were prepared with a view of their being built by contract under the provisions of the act of June 6, 1896.

The work was first advertised October 24, 1896, and bids were opened November 24, 1896, all of which were rejected under instructions from the Chief of Engineers. The work was readvertised December 2, 1896, and new bids opened December 28, 1896, were likewise rejected. A third time bids were invited on January 16, 1897, and opened on January 30, resulting in the acceptance of the proposal of the Venable Construction Company, of Atlanta, Ga. Contract was entered into with this company on March 4, 1897, and approved March 27, 1897, for the construction of the two batteries, the work to be commenced by March 20, 1897, and completed by January 1, 1898.

The cost of the contract work will be about $400,000, and this amount was allotted May 15, 1897, from the funds appropriated by the act of March 3, 1897. The cost of supervision, engineering, office, and miscellaneous expenses was estimated at $12,225, and for this purpose the sum of $1,000 was allotted on December 14, 1896, and $11,225 on March 18, 1897.

The contractors took immediate steps upon the execution of their contract for carrying out its provisions, and have been actively engaged upon the erection of their plant and accumulation of material up to the close of the fiscal year. They have quite an extensive plant now nearing completion, but with the exception of a small amount of excavation they have as yet done no actual work on the batteries, as their material

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for construction is not yet on the ground, but it is daily expected to arrive. Their plant consists, briefly, of the following:

A pile bent wharf 1,550 feet long by 14 feet wide. The pierhead is 320 by 50 feet and lies in 22 feet of water.
A machine shop 30 by 40 feet.
Two cement sheds 30 by 152 feet and 30 by 60 feet, respectively.
Boiler house, blacksmith shop, commissary, mess hall, office, storehouse, barracks, etc.
Two fresh-water tanks, one having a capacity of 10,363 gallons and the other a capacity of 15,780 gallons.
One salt-water tank, capacity about 1,000 gallons.
One 80-horsepower horizontal boiler.
One 50-horsepower horizontal stationary engine.
One 20-horsepower horizontal boiler.
One 15-horsepower horizontal stationary engine.
Three double-drum hoists operated by shafting from stationary engines, used to operate the derricks that feed the concrete mixers.
Two 15-horsepower double-drum hoisting engines, with boilers, to operate cantilever hoists.
Two cantilevers for depositing concrete and sand in place.
Three cubical concrete mixers, 5 feet edge, axial water feed, operated by shafting from stationary engines.
Two 25-horsepower locomotives, gauge 3 feet 3 inches, second-hand.
Forty dump cars, capacity about 2 cubic yards each, second-hand.
Three lines of railroad track leading from wharf to works.
Three stiff-leg derricks, 42-foot mast, 50-foot boom, for feeding concrete mixers.
Four traveling derricks on wharf for unloading vessels; each is complete and independent, and all four are alike. Derrick, boiler, and engine rest on a car 23 by 10 feet, which travels on a track built on the wharf. Derricks are of stiff-leg type, with 18-foot mast and 30-foot boom. Fifteen-horsepower upright boiler; 12 horsepower upright engine, double cylinder, 3 single drums. One double drum on single shaft for turning the derrick about vertical axis. Each derrick can lift about 3 tons with a single block.
In the machine shop they have: 1 drill press; 1 lathe, 18-inches swing, 8-foot bed; 1 iron planer, 5 feet by 1 foot 8 inches by 1 foot 8 inches; 1 band saw; 1 main shaft 100 feet long.

The cantilevers mentioned above are practically the same as traveling cranes. The plan of operation will be about as follows: Materials will be brought from wharf on cars and deposited in sheds, bins, etc.; they will be picked up in proper proportions by derrick skip and raised to the mixer; after charge is mixed it will drop into the car; car will then be run out to the cantilever; latter will pick up the car bed, hoist it, run it out on the crane till above its place of deposit, lower and dump it, and return the bed to its car; car then returns to mixer for another charge.

The plant, if properly operated, should be able to place materials as fast as vessels can deliver them at the dock.

Money statements.

FOR CONTRACT WORK.

May 13, 1897, allotted		$400,000.00
July 1, 1897, balance unexpended		400,000.00
July 1, 1897, amount due contractor for work done		603.51
July 1, 1897, balance available		399,396.49

FOR EXPENSES OF OFFICE, ENGINEERING, AND SUPERVISION.

December 14, 1896, allotted	$1,000.00	
March 18, 1897, allotted	11,225.00	
		$12,225.00
June 30, 1897, amount expended during fiscal year		2,757.03
July 1, 1897, balance unexpended		9,467.97
July 1, 1897, outstanding liabilities		404.94
July 1, 1897, balance available		9,063.03

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Mining casemate and cable gallery.—Plans were prepared and approved for the construction of a mining casemate, with cable gallery. The cost was estimated at $10,000, and this amount was allotted November 13, 1896.

Work was begun by hired labor on February 26, 1897, but owing to unexpected difficulties in obtaining secure foundation, etc., progress has not been as rapid as was contemplated. The foundations have been put in, all masonry walls have been completed as high as the springing lines of the arches, and the cable gallery has been completed.

The original design contemplated an arch roof similar to the typical design, but it having appeared desirable to construct the roof flat supported by steel beams this change was authorized under date of June 17, 1897. Operations at the end of the year are suspended, awaiting the delivery of the steel beams.

The details of the work are as follows:

The original project contemplated a concrete and sand structure, similar in design to the typical casemate, but with the following modifications:

(*a*) The main room to be enlarged to an area of 15 by 18 feet, the arch to span its shortest dimension.

(*b*) The thickness of cover to be increased to 19 feet at the thinnest point and a minimum of 25 feet on the exposed side. The original site consisted of light coral sand overlying the original coral rock. The reference of the surface of the sand was about +7, and that of the coral surface about −6, the latter sloping slightly downward toward the west.

As the weight to be supported by the casemate walls will amount to about 6 tons per square foot under the arch, an experiment was made to determine whether it would be safe to found these walls on the unprepared soil. The experiment was similar to those ordinarily made for this purpose, that is, a mast about 1 foot square in cross section was set up vertically and loaded to a weight of about 7 tons, the load consisting of twelve granite blocks, each weighing between 1,000 and 1,200 pounds, which were placed upon a horizontal frame spiked to the mast. The stones were laid one at a time, and with as little shock and motion to the mast as possible.

The foot of the mast rested at the beginning of the experiment upon the unprepared soil, about 1 foot below the natural surface. Level observations showed that the mast settled about 2.3 feet under this load, each stone as it was laid on producing a settlement of 1 to 3 inches, and settlement was apparently still taking place two days after the last stone was laid on. The natural foundation being evidently unsafe for such a heavy structure, it was at first determined to excavate and found the walls on bed rock. After reaching the water level, however, it was found so difficult to go deeper with the means at hand (there being no pump of any kind available except a small hand pump) that this project was abandoned and a wooden grillage decided upon. The grillage consists of heavy ranging timbers, averaging about 18 inches square, placed side by side just below the water level, and bound together by cross battens. These timbers are 30 feet long, and extend entirely across the casemate, projecting 3½ feet beyond each of the side walls.

The walls are founded directly on the grillage, and seem to be perfectly stable, no settlement whatever being perceptible.

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The masonry consists chiefly of concrete, though 150 cubic yards of quarry-faced granite blocks have been used, principally in the lower courses of the walls. Most of the concrete consists of one part Hoffman Rosendale cement, one-half part coral sand, and three and one-half parts broken brickbats. Broken brick was used instead of coral, the only rock obtainable here, because the latter is so friable that it crumbles in tamping. Several mixtures less rich in cement were tried, but the results were so poor that the above proportions were finally adopted.

The cement showed fair tests, both in neat briquets and with "Standard sand," but with the calcareous sand, which alone is obtainable here, the tests were very poor; hence the poor quality of the less rich concrete must be attributed directly to the sand. A large number of tests were made with the Fairbanks testing machine No. 3184. A résumé of these tests is given below.

Results of tests of Rosendale cement.

Number of briquets tested.	Composition of briquets.	Kind of sand.	Kind of water.	Time in air before immersed.	Total age of briquets.	Average tensile strength in pounds per square inch.
5	Neat		Fresh		1 day	80.2
21	Neat		Salt		1 day	103.3
2	Neat		Fresh		1 week	199.0
7	Neat		Salt		1 week	165.7
3	Neat		Fresh		1 month	197.7
4	Neat		Salt		1 month	284.2
3	Neat		Fresh	24 hours	1 week	121.3
18	Neat		Salt	24 hours	1 week	137.0
14	Neat		Fresh	Till set	1 month	241.6
16	Neat		Salt	Till set	1 month	223.3
4	1 to 1	Coral	Fresh		1 day	21.9
6	1 to 1	Coral	Fresh		1 week	57.3
12	1 to 1	Coral	Salt		1 day	37.9
8	1 to 1	Coral	Salt		1 week	85.3
6	1 to 1	Coral	Fresh		1 month	101.2
8	1 to 1	Coral	Salt		1 month	151.9
25	1 to 2	Coral	Fresh		1 day	15.0
4	1 to 2	Coral	Fresh		1 week	30.9
18	1 to 2	Coral	Salt		1 week	29.6
6	1 to 2	Coral	Fresh		1 month	39.1
20	1 to 2	Coral	Salt		1 month	54.5
8	1 to 2	Coral	Fresh		1 day	13.8
4	1 to 1	Standard	Fresh		1 day	54.4
9	1 to 1	Standard	Salt		1 day	53.1
2	1 to 1	Standard	Fresh		1 week	87.5
6	1 to 1	Standard	Salt		1 week	101.9
3	1 to 1	Standard	Fresh		1 month	151.0
4	1 to 1	Standard	Salt		1 month	202.5
3	1 to 2	Standard	Fresh		1 day	21.3
6	1 to 2	Standard	Salt		1 day	15.6
2	1 to 2	Standard	Fresh		1 week	46.4
4	1 to 2	Standard	Salt		1 week	40.2
4	1 to 2	Standard	Fresh		1 month	115.1
5	1 to 2	Standard	Salt		1 month	71.7
2	1 to 1	Pickens	Salt		1 day	76.2
1	1 to 1	Pickens	Salt		1 week	110.0
6	1 to 1	Coral	Salt	24 hours	1 week	66.6
2	1 to 1	Pickens	Salt	24 hours	1 week	88.5
4	1 to 2	Coral	Salt	24 hours	1 week	21.5
1	1 to 2	Pickens	Salt		1 week	37.0
4	1 to 1	Coral	Salt	24 hours	1 month	122.5
1	1 to 1	Pickens	Salt		1 month	212.0
3	1 to 2	Coral	Salt	24 hours	1 month	71.6
1	1 to 2	Pickens	Salt		1 day	10.0
1	1 to 2	Pickens	Salt		1 month	45.0
2	Neat	Pickens	Salt		2 weeks	277.0
5	1 to 1	Standard	Salt	24 hours	1 week	97.6
1	1 to 1	Standard	Salt		1 month	224.0
2	1 to 2	Standard	Salt		1 week	27.0
2	1 to 2	Standard	Salt		1 month	57.7

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Money statement.

November 13, 1896, allotted	$10,000.00
June 30, 1897, amount expended during fiscal year	5,198.84
July 1, 1897, balance unexpended	4,801.16
July 1, 1897, outstanding liabilities	416.46
July 1, 1897, balance available	4,384.70

Purchase of sites.—Negotiations were had with the owners with a view to the purchase of the land needed for two sites. These sites are needed for occupation by modern defensive works contemplated by the approved project.

An agreement was reached with the representative of the Livermore estate for the purchase of one site for $4,600, and authority was granted and an allotment made by the Department for the consummation of the purchase.

The title to the property was examined by the United States district attorney for the southern district of Florida and a deed was executed by the owners. All the title papers were forwarded for reference to the Attorney-General on June 15, 1897, and if found by him to be sufficient to vest title in the United States the purchase price will be paid.

No satisfactory agreement could be made with the owners of the second site, the price demanded being excessive. Accordingly, proceedings for the condemnation of this land have been instituted by the United States district attorney, and it is understood that the case is on the docket for trial at the February next term of court.

The sum of $100 was allotted for incidental expenses connected with the acquirement of these sites.

Money statement.

January 26, 1897, allotted	$4,600.00
April 30, 1897, allotted	100.00
	4,700.00
June 30, 1897, amount expended during fiscal year	7.05
July 1, 1897, balance unexpended and available	4,692.95

Preservation and repair.—At the beginning of the year there was a balance available of former allotments amounting to $1,198.88. Under date of August 19, 1896, an additional allotment of $201.12 was made, making a total of $1,400 available for payment of salary of fort keeper at $60 per month during the balance of the year and for making the most necessary repairs to the fort, etc.

Repairs were made during the year to the engineer office and other buildings and to the fences, the grounds were cared for, and the large amount of property stored at the fort was kept in good condition.

The bridge leading to the fort being in a very much decayed condition and unsafe for use in transporting material for use in the construction of the mining casemate, an allotment of funds for its repair was recommended, and the sum of $1,500 was allotted for this purpose. The repairs were commenced and are still under way at the close of the year.

An estimate was submitted January 12, 1897, of amount necessary for protection, preservation, and repair during the fiscal year 1898, and on June 14, 1897, the sum of $2,000 was allotted for making the most necessary repairs. The services of a fort keeper will be dispensed with from the beginning of the new fiscal year and while the construction of new works continues.

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Money statement.

July 1, 1896, balance unexpended	$1,198.88
August 4, 1896, allotted	201.12
March 8, 1897, allotted	1,500.00
June 14, 1897, allotted	2,000.00
	4,900.00
June 30, 1897, amount expended during fiscal year	1,173.02
July 1, 1897, balance unexpended	3,726.98
July 1, 1897, outstanding liabilities	918.13
July 1, 1897, balance available	2,808.85

Abstracts of proposals for construction of gun and mortar batteries received in response to advertisement dated October 24, 1896, and opened November 24, 1896.

Items.	Quantity.	1. Stewart Contracting Co., Columbia, S. C.		2. Roderick G. Ross, Jacksonville, Fla.		3. John L. Grim, Philadelphia, Pa.	
		Rate per unit.	Total.	Rate per unit.	Total.	Rate per unit.	Total.
Excavation, sand, measured in place, cubic yards	1,950	$0.30	$585.00	$0.25	$487.00	$0.28	$546.00
Excavation coral, measured in place, cubic yards	500	1.00	500.00	.60	300.00	1.20	600.00
Fill sand (excess of excavation), measured in place....cubic yards	152,000	.85	129,200.00	.33	50,160.00	.40	60,800.00
Fill loam, measured in place, cubic yards	2,450	1.00	2,450.00	.90	2,205.00	.80	1,960.00
Bermuda grass covering, measured in place.....square yards	10,950	.10	1,095.00	.60	6,570.00	.25	2,737.50
Concrete:							
No. 1, measured in place, cubic yards	27,175	7.00	190,225.00	8.50	230,987.50	7.20	195,660.00
No. 2 (platforms), measured in place.....cubic yards	4,600	8.50	39,100.00	10.40	47,840.00	8.50	39,100.00
No. 3 (facings), measured in place, cubic yards	2,600	13.77	35,802.00	13.00	33,800.00	11.50	29,900.00
Cut stone, measured in place, cubic yards	115	70.00	8,050.00	60.00	6,900.00	65.00	7,475.00
Large stone (embedded in concrete No. 1).....tons (2,000 pounds)	8,900	5.00	44,500.00	4.50	40,050.00	3.95	35,155.00
Pavements, measured in place, square yards	2,100	2.22	4,662.00	1.15	2,415.00	2.50	5,250.00
Beams, plates, etc., with standard connections, in place.....pounds	129,300	.04	5,172.00	.03½	4,525.50	.03½	4,525.50
Steel anchoring bolts, in place, pounds	45,500	.06	2,805.83	.06½	2,957.50	.07	3,185.00
Doors in place	73	21.60	1,576.80	10.00	730.00	30.00	2,190.00
Brass fittings for doors, in place, pounds	3,600	.60	2,160.00	.40	1,440.00	.70	2,520.00
Iron fittings for doors, in place, pounds	11,430	.10	1,143.00	.10	1,143.00	.20	2,286.00
6-inch vitrified pipe, in place, linear feet	225	.50	112.50	.40	90.00	.38	85.50
10-inch vitrified pipe, in place, linear feet	275	.90	247.50	.50	137.50	.80	220.00
3-inch porous drain pipe, in place, linear feet	1,225	.35	428.75	.25	306.25	.25	306.25
Lumber for electric wiring, in place, feet B. M	325	100.00	32.50	70.00	22.75	80.00	26.00
Steel trolley beams, trolleys, bolts, hangers, etc, in place.....pounds	49,500	.12	5,940.00	.10	4,950.00	.12	5,940.00
Asphalt covering in place, square yards	1,700	.75	1,275.00	1.50	2,250.00	1.85	3,145.00
Brick, in place	56,500	25.00	1,412.50	25.00	1,412.50	39.00	2,203.50
Iron ladders, in place.....pounds	300	.14	42.00	.07	21.00	.12	36.00
Brass speaking tubes, with mouthpieces, in place.....linear feet	850	.50	425.00	.30	255.00	.50	425.00
Cast-iron stairs, in place....pounds	13,500	.06	810.00	.07	1,012.50	.05	712.50
Cranes, complete, in place	12	350.00	4,200.00	200.00	2,400.00	300.00	3,600.00
Ammunition hoists, complete, in place	12	600.00	7,200.00	300.00	3,600.00	600.00	7,200.00
4-inch cast-iron pipe, in place, linear feet	190	.65	123.50	.10	19.00	.65	123.50
Cast-iron 4-inch tees, with covers, in place	240	.95	228.00	.20	48.00	.99	237.60
Total			491,503.88		449,335.50		418,180.85

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Abstracts of proposals for construction of gun and mortar batteries received in response to advertisement dated December 2, 1896, and opened December 28, 1896.

Items.	Quantity.	1. Roderick G. Ross, Jacksonville, Fla.		2. Wm. T. Gayner, Fayetteville, N. Y.	
		Rate per unit.	Total.	Rate per unit.	Total.
Excavation, sand, measured in place, cubic yards	1,950	$0.38	$741.00	$0.40	$780.00
Excavation coral, measured in place.....do....	500	1.20	600.00	1.50	750.00
Fill sand (excess of excavation), measured in place, cubic yards	152,500	.38	57,760.00	.41	62,320.00
Fill loam, measured in place.....cubic yards	2,450	.90	2,205.00	.90	2,205.00
Bermuda grass covering.....square yards	10,950	.15	1,642.50	.20	2,190.00
Concrete:					
No. 1, measured in place.....cubic yards	27,175	8.39	227,998.25	7.80	211,965.00
No. 2 (platforms), measured in place, cubic yards	4,600	9.53	43,838.00	9.00	41,400.00
No. 3 (facing), measured in place, cubic yards	2,600	13.24	34,424.00	12.50	32,500.00
Cut stone, measured in place.....do....	115	60.00	6,900.00	60.00	6,900.00
Large stone (embedded in concrete No. 1) tons (2,000 pounds)	8,900	4.00	35,600.00	5.00	44,500.00
Pavements, measured in place.....square yards	2,100	1.45	3,045.00	1.50	3,150.00
Beams, plates, etc., with standard connections, in place.....pounds	129,300	.03½	4,525.50	.04	5,172.00
Steel anchoring bolts, in place.....pounds	45,500	.06½	2,957.50	.07	3,185.00
Doors, in place	73	15.00	1,095.00	15.00	1,095.00
Brass fittings for doors, in place.....pounds	3,600	.50	1,800.00	.60	2,160.00
Iron fittings for doors, in place.....do....	11,430	.10	1,143.00	.10	1,143.00
6-inch vitrified pipe, in place.....linear feet	225	.40	90.00	.90	202.50
10-inch vitrified pipe, in place.....do....	275	.80	220.00	.90	247.50
3-inch porous drain pipe, in place.....do....	1,225	.25	306.25	.20	245.00
Lumber for electric wiring, in place....feet B. M.	325	70.00	22.75	50.00	16.25
Steel trolley beams, trolleys, hangers, etc., in place, pounds	49,500	.20	9,900.00	.25	12,375.00
Asphalt covering, in place.....square yards	1,700	1.00	1,700.00	3.00	5,100.00
Brick, in place	36,500	55.00	912.50	14.00	511.00
Iron ladders, in place.....pounds	300	.10	30.00	.04	12.00
Brass speaking tubes, with mouthpieces, in place, linear feet	850	.50	425.00	.10	85.00
Cast-iron stairs, in place.....pounds	13,500	.07	945.00	.10	135.00
Cranes, complete, in place	12	250.00	3,000.00	250.00	3,000.00
Ammunition hoists, complete, in place	12	500.00	6,000.00	50.00	600.00
4-inch cast-iron pipe, in place.....linear feet	190	.50	95.00	.10	19.00
Cast iron 4-inch tees, with covers, in place	240	.90	216.00	.25	60.00
Manhole covers and fittings, in place	6	1.00	6.00	1.00	60.00
Galvanized sheet iron or boiler plate, in place, pounds	1,200	.05	60.00	.10	120.00
1¼-inch wrought-iron pipe for railing, in place, linear feet	1,350	.10	135.00	.10	135.00
2-inch wrought-iron pipe for railing posts, with fittings, linear feet	660	.15	99.00	.10	66.00
Total			450,437.25		444,404.25

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Abstracts of proposals for construction of gun and mortar batteries received in response to advertisement dated December 2, 1896, and opened December 28, 1896—Continued.

Items.	Quantity.	3. E. J. McKeever and Andrew R. Baird, Brooklyn, N. Y.		4. Mairs, Lewis & Hodge, New York City, N. Y.	
		Rate per unit.	Total.	Rate per unit.	Total.
Excavation, sand, measured in place, cubic yards	1,950	$0.30	$585.00	$0.25	$487.50
Excavation coral, measured in place, do	500	.48	240.00	1.00	500.00
Fill sand (excess of excavation), measured in place, cubic yards	152,500	.36	54,720.00	.50	76,000.00
Fill loam, measured in place, cubic yards	2,450	1.20	2,940.00	1.00	2,450.00
Bermuda grass covering, square yards	10,950	.29	3,175.50	.25	2,737.50
Concrete:					
No. 1, measured in place, cubic yards	27,175	7.20	195,660.00	6.65	180,713.75
No. 2 (platforms), measured in place, cubic yards	4,600	9.10	41,860.00	8.70	40,020.00
No. 3 (facing), measured in place, cubic yards	2,600	10.50	26,390.00	11.50	29,900.00
Cut stone, measured in place, do	115	46.00	5,290.00	50.00	5,750.00
Large stone (embedded in concrete No. 1) tons (2,000 pounds)	8,900	4.00	35,000.00	3.60	32,040.00
Pavements, measured in place, square yards	2,100	1.10	2,310.00	1.00	2,100.00
Beams, plates, etc., with standard connections, in place, pounds	129,300	.04	5,172.00	.03	3,879.00
Steel anchoring bolts, in place, pounds	45,500	.06	2,730.00	.05	2,275.00
Doors, in place	73	17.00	1,241.00	15.00	1,095.00
Brass fittings for doors, in place, pounds	3,600	.42	1,512.00	.35	1,260.00
Iron fittings for doors, in place, do	11,430	.10	1,143.00	.10	1,143.00
6-inch vitrified pipe, in place, linear feet	225	.36	81.00	1.00	225.00
10-inch vitrified pipe, in place, do	275	.50	137.50	1.00	275.00
3-inch porous drain pipe, in place, do	1,225	.30	367.50	.50	612.50
Lumber for electric wiring, in place, feet B. M.	325	.10	32.50	50.00	16.25
Steel trolley beams, trolleys, hangers, etc., in place, pounds	49,500	.10	4,950.00	.15	7,425.00
Asphalt covering, in place, square yards	1,700	1.10	1,870.00	.75	1,275.00
Brick, in place	86,500	25.00	912.50	25.00	1,412.50
Iron ladders, in place, pounds	300	.06	18.00	.08	24.00
Brass speaking tubes, with mouthpieces, in place, linear feet	850	.30	255.00	.25	212.50
Cast-iron stairs, in place, pounds	13,500	.06	810.00	.05	675.00
Cranes, complete, in place	12	180.00	2,160.00	250.00	3,000.00
Ammunition hoists, complete, in place	12	300.00	3,600.00	1,200.00	14,400.00
4-inch cast-iron pipe, in place, linear feet	190	.10	19.00	.50	95.00
Cast iron 4-inch tees, with covers, in place	240	.30	72.00	1.00	240.00
Manhole covers and fittings, in place	6	10.00	60.00	15.00	90.00
Galvanized sheet iron or boiler plate, in place, pounds	1,200	.05	60.00	.05	60.00
1¼-inch wrought-iron pipe for railing, in place, linear feet	1,350	.20	270.00	.20	270.00
2-inch wrought-iron pipe for railing posts, with fittings, linear feet	660	.35	231.00	.30	198.00
Total			396,474.50		412,856.50

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Abstracts of proposals for construction of gun and mortar batteries received in response to advertisement dated December 2, 1896, and opened December 28, 1896—Continued.

Items.	Quantity.	5. Venable Construction Co., Atlanta, Ga.		6. Stewart Contracting Co., Columbia, S. C.		7. John L. Grim, Philadelphia, Pa.	
		Rate per unit.	Total.	Rate per unit.	Total.	Rate per unit.	Total.
Excavation, sand, measured in place, cubic yards	1,950	$0.25	$487.50	$0.30	$585.00	$0.28	$546.00
Excavation coral, measured in place, cubic yards	500	.60	300.00	.75	375.00	.60	300.00
Fill sand (excess of excavation), measured in place, cubic yards	152,500	.38	57,760.00	.38	57,760.00	.38	57,760.00
Fill loam, measured in place, cubic yards	2,450	1.00	2,450.00	.95	2,327.50	.80	1,960.00
Bermuda grass covering, square yards	10,950	.45	4,927.50	.30	3,285.00	.25	2,737.50
Concrete:							
No. 1, measured in place, cubic yards	27,175	7.00	190,225.00	7.50	203,812.50	7.00	190,225.00
No. 2 (platforms), measured in place, cubic yards	4,600	8.50	39,100.00	8.25	37,950.00	8.50	39,100.00
No. 3 (facing), measured in place, cubic yards	2,600	13.00	33,800.00	12.50	32,500.00	11.50	29,900.00
Cut stone, measured in place, cubic yards	115	65.00	7,475.00	60.00	6,900.00	60.00	6,900.00
Large stone (embedded in concrete No. 1), tons (2,000 pounds)	8,900	3.90	34,710.00	3.80	33,820.00	3.95	35,155.00
Pavements, measured in place, square yards	2,100	1.20	2,520.00	1.40	2,940.00	2.00	4,200.00
Beams, plates, etc., with standard connections, in place ....pounds	129,300	.03	4,525.50	.03	4,202.25	.03	4,525.50
Steel anchoring bolts, in place, pounds	45,500	.06	2,957.50	.06	2,730.00	.07	3,185.00
Doors, in place	73	10.00	730.00	18.00	1,314.00	30.00	2,190.00
Brass fittings for doors, in place, pounds	3,600	.40	1,440.00	.50	1,800.00	.70	2,520.00
Iron fittings for doors, in place, pounds	11,430	.10	1,143.00	.10	1,143.00	.20	2,280.00
6-inch vitrified pipe, in place, linear feet	225	.35	78.75	.60	135.00	.38	85.50
10-inch vitrified pipe, in place, linear feet	275	.40	110.00	.40	110.00	.80	220.00
3-inch porous drain pipe, in place, linear feet	1,225	.24	294.00	.25	306.25	.25	306.25
Lumber for electric wiring, in place, feet B. M	325	70.00	22.75	90.00	29.25	80.00	26.00
Steel trolley beams, trolleys, hangers, etc., in place, pounds	49,500	.10	4,950.00	.08	3,960.00	.13	6,435.00
Asphalt covering, in place, square yards	1,700	1.80	3,060.00	.75	1,190.00	1.85	3,145.00
Brick, in place	36,500	30.00	1,095.00	25.00	912.50	39.00	1,423.50
Iron ladders, in place.....pounds	300	.15	45.00	.10	30.00	.12	36.00
Brass speaking tubes, with mouthpieces, in place, linear feet	850	.30	255.00	.40	340.00	.50	425.00
Cast-iron stairs, in place...pounds	13,500	.06	810.00	.08	1,080.00	.05	742.50
Cranes, complete, in place	12	50.00	600.00	275.00	3,300.00	300.00	600.00
Ammunition hoists, complete, in place	12	125.00	1,500.00	550.00	6,600.00	600.00	7,200.00
4-inch cast-iron pipe, in place, linear feet	190	.50	95.00	.60	114.00	.65	123.50
Cast iron 4-inch tees, with covers, in place	240	1.25	300.00	.70	168.00	.99	237.60
Manhole covers and fittings, in place	6	4.00	24.00	7.00	42.00	30.00	180.00
Galvanized sheet iron or boiler plate, in place, pounds	1,200	.10	120.00	.25	300.00	.07	84.00
1¼-inch wrought-iron pipe for railing, in place, linear feet	1,350	.60	810.00	.20	270.00	.20	270.00
2-inch wrought-iron pipe for railing posts, with fittings, linear feet	660	.60	396.00	.60	396.00	.35	231.00
Total			399,116.50		412,727.25		408,260.85

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Abstracts of proposals for construction of gun and mortar batteries received and opened January 30, 1897, in response to advertisement dated January 16, 1897.

Items.	Quantity.	1. E. J. McKeever and Andrew R. Baird, Brooklyn, N. Y.		2. J. W. Hoffman & Co., Philadelphia, Pa.		3. John L. Grim, Philadelphia, Pa.	
		Rate per unit.	Total.	Rate per unit.	Total.	Rate per unit.	Total.
Excavation, measured in place, cubic yards	1,950	$0.30	$585.00	$0.30	$585.00	$0.28	$546.00
Excavation, coral, measured in place, cubic yards	500	.50	250.00	.50	250.00	.60	300.00
Fill sand (excess of excavation), measured, in place...cubic yards	152,000	.36	54,720.00	.37	56,240.00	.36	54,720.00
Fill loam, measured in place, cubic yards	2,450	.80	1,960.00	.90	2,205.00	.80	1,960.00
Bermuda grass covering, measured, in place.....square yards	10,950	.15	1,642.50	.25	2,737.50	.15	1,642.50
Concrete:							
No. 1, measured in place, square yards	27,175	7.30	198,377.50	7.30	198,377.50	6.75	183,431.25
No. 2 (platforms), measured in place.....cubic yards	4,600	9.00	41,400.00	8.60	39,560.00	8.00	36,800.00
No. 3 (facings), measured, in place, cubic yards	2,600	9.50	24,700.00	10.05	26,130.00	11.00	28,600.00
Cut stone, measured in place, cubic yards	115	40.00	4,600.00	50.00	5,750.00	60.00	6,900.00
Large stone (embedded in concrete No. 1).....tons (2,000 pounds)	8,900	3.50	31,150.00	3.50	31,150.00	3.80	33,820.00
Pavements, measured in place, square yards	2,100	1.10	2,610.00	1.00	2,100.00	1.80	3,780.00
Beams, plates, etc., with standard connections, in place.....pounds	129,300	.03½	4,202.25	.04	5,172.00	.03½	4,525.50
Steel anchoring bolts, in place, pounds	45,500	.06	2,730.00	.06	2,730.00	.06	2,730.00
Doors, in place	73	10.00	730.00	18.00	1,314.00	20.00	1,460.00
Brass fittings for doors, in place, pounds	3,600	.35	1,260.00	.42	1,512.00	.60	2,160.00
Iron fittings for doors, in place, pounds	11,430	.09	1,028.70	.10	1,143.00	.10	1,143.00
6-inch vitrified pipe, in place, linear feet	225	.36	81.00	.40	90.00	.40	90.00
10-inch vitrified pipe, in place, linear feet	275	.50	137.50	.50	137.50	.80	220.00
3-inch porous drainpipe, in place, linear feet	1,225	.20	245.00	.30	367.50	.25	306.25
Interior conduit for electric wiring, linear feet	125	.10	12.50	.10	12.50	.25	31.25
Steel trolley beams, trolleys, hangers, etc., in place.....pounds	49,500	.10	4,950.00	.08	3,960.00	.13	6,435.00
Asphalt covering, in place, square yards	1,700	1.10	1,870.00	1.20	2,040.00	1.50	2,550.00
Brick, in place	36,500	25.00	912.50	30.00	1,095.00	40.00	1,460.00
Iron ladders, in place.....pounds	300	.06	18.00	.10	30.00	.12	36.00
Brass speaking tubes with mouth-pieces, in place.....linear feet	850	.30	255.00	.40	340.00	.40	340.00
Cast-iron stairs, in place...pounds	13,500	.06	810.00	.06	810.00	.06	810.00
Cranes, complete, in place	12	80.00	2,160.00	200.00	2,400.00	300.00	3,600.00
Ammunition hoists, complete, in place	12	300.00	3,600.00	275.00	3,300.00	600.00	7,200.00
4-inch cast iron pipe, in place, linear feet	190	.10	19.00	.10	19.00	.65	123.00
Cast-iron 4-inch tees, with covers, in place	240	.30	72.00	.35	82.00	1.00	240.00
Manholes, covers, and fittings, in place	6	10.00	60.00	15.00	90.00	25.00	150.00
Galvanized sheet iron or boiler plate, in place, pounds	1,200	.05	60.00	.10	120.00	.07	84.00
1¼-inch wrought-iron pipe for railing, in place.....linear feet	1,350	.20	270.00	.20	270.00	.20	270.00
2-inch wrought-iron pipe for railing posts, with fittings, linear feet	660	.35	231.00	.35	231.00	.40	264.00
Total			387,409.45		392,352.50		388,728.25

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Abstracts of proposals for construction of gun and mortar batteries received and opened January 30, 1897, in response to advertisement dated January 16, 1897—Continued.

Items.	Quantity.	4. Ross, McLain & Howe, Jacksonville, Fla.		5. Venable Construction Company, Atlanta, Ga.	
		Rate per unit.	Total.	Rate per unit.	Total.
Excavation, measured in place..cubic yards..	1,950	$0.31	$604.50	$0.25	$487.50
Excavation, coral, measured in place, cubic yards	500	1.25	625.00	.60	300.00
Fill sand (excess of excavation), measured in place.....cubic yards..	152,000	.47	71,440.00	.28	42,560.00
Fill loam, measured in place.....do....	2,450	1.25	3,062.50	1.00	2,450.00
Bermuda grass covering, measured in place, square yards	10,950	.19	2,080.50	.25	2,737.50
Concrete:					
No. 1, measured in place....square yards..	27,175	7.88	214,139.00	7.00	190,225.00
No. 2 (platforms), measured in place, cubic yards	4,600	8.60	39,560.00	8.00	36,800.00
No. 3 (facings), measured in place, cubic yards	2,600	11.41	29,665.00	13.00	33,800.00
Cut stone, measured in place....cubic yards..	115	62.50	7,187.50	65.00	7,475.00
Large stone (embedded in concrete No. 1), tons (2,000 pounds)	8,900	3.25	28,925.00	3.60	32,040.00
Pavements, measured in place, square yards..	2,100	1.06	2,226.00	1.20	2,520.00
Beams, plates, etc., with standard connections, in place.....pounds..	129,300	.04 7/10	6,077.10	.03½	4,525.50
Steel anchoring bolts, in place.....do....	45,500	.06⅔	2,843.75	.06	2,730.00
Doors, in place	73	18.75	1,368.75	15.00	1,095.00
Brass fittings for doors, in place.....pounds..	3,600	.62½	2,250.00	.45	1,620.00
Iron fittings for doors, in place.....do....	11,430	.12½	1,428.75	.10	1,143.00
6-inch vitrified pipe, in place.....linear feet..	225	.31	69.75	.50	112.50
10-inch vitrified pipe, in place.....do....	275	.62½	171.87	.60	165.00
3-inch porous drainpipe, in place.....do....	1,225	.19	232.75	.30	367.50
Interior conduit for electric wiring.....do....	125	.16½	20.31	.20	25.00
Steel trolley beams, trolleys, hangers, etc., in place.....pounds..	49,500	.12½	6,187.50	.12	5,940.00
Asphalt covering, in place.....square yards..	1,700	1.25	2,125.00	1.20	2,040.00
Brick, in place	36,500	31.25	1,140.62	28.00	1,022.00
Iron ladders, in place.....pounds..	300	.12½	37.50	.20	60.00
Brass speaking tubes with mouthpieces, in place.....linear feet..	850	.32	272.00	.35	297.50
Cast-iron stairs, in place.....pounds..	13,500	.07½	1,012.50	.07	945.00
Cranes, complete, in place	12	250.00	3,000.00	69.00	828.00
Ammunition hoists, complete, in place	12	469.00	5,628.00	290.00	3,480.00
4-inch cast-iron pipe, in place.....linear feet..	190	.62½	118.75	.40	76.00
Cast-iron 4-inch tees, with covers, in place.....	240	.37½	90.00	1.00	240.00
Manholes, covers, and fittings, in place	6	8.75	52.50	8.00	48.00
Galvanized sheet iron or boiler plate, in place, pounds	1,200	.12½	150.00	.14	168.00
1¼-inch wrought-iron pipe for railing, in place, linear feet	1,350	.15	202.00	.30	405.00
2-inch wrought-iron pipe for railing posts, with fittings.....linear feet..	660	.21	138.60	.40	264.00
Total			434,734.50		378,992.00

Contract in force during fiscal year for constructing gun and mortar batteries at Key West, Fla.

Name of contractor.	Date of approval.	Date of commencement.	Date of expiration.
Venable Construction Company	Mar. 27, 1897	Mar. 20, 1897	Jan. 1, 1898.

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3 O.

DEFENSES OF PENSACOLA, FLORIDA.

Officer in charge, Maj. Frederick A. Mahan, Corps of Engineers; assistant, Lieut. James P. Jervey, Corps of Engineers; Division Engineer, Col. Peter C. Hains, Corps of Engineers.

Battery for four 10-inch guns on disappearing carriages.—The wharf having been completed and a sufficient supply of materials having been received, the work of construction of this battery was begun on November 1, 1896. The battery was all complete, and, with the exception of a few minor details, ready to receive its armament on March 29, 1897.

Lieutenant Jervey's report is so full and complete that it is incorporated here in full.

Money statement.

July 1, 1896, balance unexpended	$142,369.62
December 14, 1896, amount allotted	20,000.00
May 13, 1897, amount alloted	3,500.00
June 25, 1897, amount allotted	8,000.00
	173,869.62
June 30, 1897, amount expended during fiscal year	151,089.61
July 1, 1897, balance unexpended	22,780.01
July 1, 1897, outstanding liabilities	11,359.27
July 1, 1897, balance available	11,420.74

REPORT OF SECOND LIEUT. JAMES P. JERVEY, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Warrington, Fla., June 30, 1897.

SIR: I have the honor to submit the following report of operations on construction of battery for four 10-inch high-power guns on disappearing carriages at Pensacola Harbor, Florida, for the year ending June 30, 1897.

Battery for four 10-inch guns.—The first allotment was $100,000 for emplacements 1 and 2. Subsequent allotments of $10,000 for platforms, $50,000 for emplacement No. 3, $20,000 for emplacement No. 4, and $3,500 for turfing have been made, aggregating $183,500. On June 20, 1897, with the funds thus allotted, all the masonry, including paving and steps in the four emplacements, all sand filling, doors, drains, water piping, three platforms, model 1894, one platform, model of 1896, have been completed, with exception of railings and cranes. Arrangements have been made for the purchase of a lighting plant, ammunition conveyors, hoists, cranes, and sewerage system.

The sand slopes have been partially covered with muck.

A conduit for electric wires in rear of the battery has been nearly completed.

It is thought that the battery will be completed in all respects within the allotments.

Work was started on the erection of the plant on March 31, 1896, Concreting was commenced on November 1, 1896. The work was prosecuted night and day during November, December, and January. There was a month's delay during February, on account of lack of cement. On March 1, 1897, work was resumed, and the masonry, with exception of a few steps and paving in magazines, was completed on March 29, 1897. The mixing plant was then taken down and stored, the concrete for steps and paving being mixed by hand.

Preparations for sand filling were commenced on April 15, and the filling was completed and slopes trimmed to grade on June 15, 1897.

During April, May, and June all doors have been made and swung; a permanent system of water supply has been installed; steps have been completed; the mixing plant has been taken down and stored; plans and contracts have been made for ammunition service, lighting plant, sewerage system; turfing has been commenced, and two gun carriages, model of 1894, have been received. A detailed statement of the cost of each class of work is given under various heads which follow. Wherever possible the labor and cost for units are deduced. A few constructional details are also given. It is hoped that they may be of some assistence to other junior officers who, without previous experience, may be placed in local charge of similar constructions.

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The different classes of work are taken up in order of their actual construction:

1. WHARF.

The construction of the wharf was described in Annual Report of 1896. A detailed statement of cost is given below.

Class.	Hours.	Cost.	Total.
Receiving piles	146	$27.92	
Sharpening piles	407	76.30	
Driving piles	7,303	1,591.40	
Painting and preparing fender piles	148	27.74	
Driving fender piles	462	89.62	
Receiving terra-cotta casings for piles	234	45.93	
Putting on casings	3,584	727.59	
Mixing concrete for casings	1,578	300.72	
Tenons on heads of piles	1,010	241.25	
Scarfing stringers	624	155.78	
Framing and placing stringers	1,715	383.74	
Setting deck joists	742	147.16	
Laying deck and guard rails	2,939	637.36	
Track and turn tables	770	200.90	
Granite piers on shore end	110	20.42	
Total labor			$4,673.83
Materials.			
Lumber		1,832.95	
Piping, staples, etc		1,555.54	
Iron and steel		228.86	
Nails and bolts		331.54	
Cement		612.75	
Sundries		712.47	
			5,274.11
Total cost of wharf			9,947.94

The cost of fender piles protected with patent paint was as follows: Piles per foot, in place, $0.23; painting with patent paint per foot, $0.046.

The cost of ordinary fender piles in place was $0.30 per foot. Piles protected with sewer pipe filled with concrete, $0.62 per foot. Sharpening piles, $0.34 per pile. Framing tenon head pile, $1.20 per pile.

Scarfing stringers, $0.77 per scarf. Average cost framing, $10.67 per thousand.

TIME.

Average number of hours' labor to drive one pile, 31; average number of hours to case a pile, 25; average number of hours to frame 1,000 feet B. M., 40.

2. RAILROAD.

The road is 3 feet gauge, laid with 30-pound rails on sawn yellow-pine ties, 6 by 8 inches by 6 feet, spaced 2 feet center to center.

Class.	Hours.	Cost.	Total.
Labor.			
Unloading iron	988	$214.30	
Grading	13,115	2,811.53	
Laying cross-ties	394	72.74	
Laying rails, etc	2,202	448.46	
Railroad in front of battery	536	100.50	
Total labor			$3,647.53
Materials.			
Iron and steel		2,761.40	
Spikes and bolts		280.26	
Ties		389.93	
Towage		54.75	
Total material			3,495.34
Total cost of railroad			7,142.87

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The total length of railroad laid was 7,500 feet. The line for grading was laid with a transit, curves were put in either by deflection and chords or by tapeline and ordinates. The excavation was then made on the given line, the grade line being chosen so as to equalize cut and fill. As a general thing the filling was put in with dump cars; the track, being laid on the natural surface of the ground, was leveled up as the filling was brought in from the cuts. No pegs were set in laying and spiking rails, the tangents and curves being put in by eye. In setting guiding stakes for grading a stake was set at the proper elevation at each point where the slope changed. The foreman was then furnished with three wooden tees of equal height. Then, having a tee held on each peg at the extremities of a slope, he was enabled to bring any intermediate point to the proper grade by excavating or filling until the top of the third tee, when held at that point, was in line with the tops of the two already mentioned. All frogs and switches were made by the blacksmith employed on the work.

Unit prices:		
Grading per 100 feet		$37.00
Laying rail per 100 feet		5.98
Time:		
Grading per 100 feet	hours	176
Laying rail per 100 feet	do	30

3. Incline and Storage Bins.

Cars of materials were run directly over the storage bins, at a 5 per cent incline. The locomotive could handle ten loaded cars of 3 cubic yards capacity in this grade. The trestle bents were constructed of 10-by-10-inch timber, each bent having two posts and two braces. The bents were spaced 12 feet center to center. Each line of stringers consisted of two 8-by-12-inch timbers. Two-inch boards were used as cross-ties. No mortising was employed in the construction, everything being drift-bolted together. The extremities of the incline were connected with the horizontal portion and with the horizontal track at the foot by vertical curves.

It may be of interest to state how these curves were put in during the process of construction.

The distances from the tops of the various bents to the tangents to curves were calculated from the drawing. A small wooden tee was then nailed to each bent, so that the distance from the top of the bent to the top of the tee was equal to the tangent distance for that bent. Then by adjusting the bents, until the tops of the tees were in line, the tops of the bents would be on the curve.

Cost and labor:			
Labor			$849.09
Material:			
Iron and steel work		$27.06	
Nails, etc		128.42	
Lumber		1,265.64	
			1,421.12
Total cost			2,270.21

Average cost of framing, $8.20 per thousand.

4. Mixer.

An ordinary 4-foot cubical mixer was used. The proper charges of the various raw ingredients were measured in light handcarts. These charges were brought up and dumped into a large wooden iron-bound bucket resting in the charging hole. The charge was first raised vertically, and then run up to a 25 per cent incline over the mixer. This operation was performed by one line, the car on the incline being held in position by a counterweight until the charge was hoisted. As soon as the sheave block on the bucket came in contact with the buffer on the car, the counterweight would be raised and car and bucket would move up the incline. One hundred and seventy-five charges per day of eight hours was the maximum number attained.

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Labor:		
Framing		$749.19
Material:		
Hoisting buckets	$181.65	
Ropes	88.90	
Iron and steel	68.75	
Lumber	468.66	
Belting	32.15	
Piping	64.87	
Nails, etc	7.05	
Sundries	11.55	
Total material		923.56
Total cost		1,672.75

Average cost of framing per thousand feet, including placing machinery, $18.

5. Water Supply.

This was a very expensive item, as it was found that the water from the surface wells could not be used in the locomotive. A tank was therefore built, to be supplied from cisterns. The exhaustion of this supply necessitated the building of another tank on the wharf, which was filled by pumping from tugboats.

Class.	Hours.	Cost.	Total.
Labor.			
Pile-driver supply	32	$6.00	
Locomotive	907	229.20	
Mixer	1,576	375.94	
Total labor			$611.14
Materials.			
Pumps		182.00	
Piping		213.14	
Lumber		97.36	
Nails		2.00	
Sundries		608.44	
Total material			1,102.94
Total cost			1,714.08

It is to be noted that this head includes all expenses from the beginning of the work.

A violent freeze in February, 1897, burst nearly all pipes, necessitating extensive repairs.

6. Forms.

Placing and removing boxes around anchor bolts		$66.84
Framing forms for platform		1,765.30
Removing forms from platform		76.11
Forms for paving		83.63
Framing forms for rest of work		4,237.29
Removing		500.79
Total labor		6,729.96
Material:		
Lumber	$3,035.98	
Nails, etc	205.90	
Iron and steel	2.19	
Total material		3,244.07
Total cost		9,974.03

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Average cost of framing per thousand, $23.60; average cost of nails per thousand feet B. M., $0.81; average hours of labor for framing 1,000 feet B. M., 103; average cost per thousand for removing forms, $2.28; average hours of labor to remove 1,000 B. M. forms, 0.9.

In removing forms the posts were easily forced off with jackscrews.

7. Miscellaneous Plant.

	Total cost.
Pile driver	$237.76
Hoisting engines	348.46
Traveling derrick	735.60
Rolling stock	1,961.91
Locomotive	3,530.06
Tools	638.55
Boats and lighters	3,700.00
Carpenter shed, tool houses, oil house, and office	1,388.16
Miscellaneous items	514.02
Derrick on wharf	227.55
Lighting plant	181.33
Locomotive pit	23.25
Locomotive turntable	81.75
Total	13,568.40

8. Cost of Materials for Concrete Stored at Mixer.

Class.	Quantity.	Cost per yard.	Total cost.
Pebbles, cubic yards	6,082.7	$3.09	$18,794.81
Broken stone, do	6,456	3.39	21,008.92
Rubblestone, do	2,000	5.58	11,168.60
Sand, do	2,500	.549	1,373.77
			53,246.10
Portland cement, barrels	2,558	*2.393	
Louisville cement, do	997	*1.593	22,001.92
Rosendale cement, do	12,580	*1.143	
Total			75,248.02

*Per barrel.

9. Sand Filling.

The sand filling was put in partly by hired labor and partly by contract. The incline over the storage bins was utilized in placing the sand. The maximum day's work was 1,000 cubic yards.

Cost.—40,000 cubic yards; $0.308 per cubic yard; total cost of, $12,323.12

10. Steel Beams.

The total cost in place for the four emplacements was $2,099.47; the labor placing was $195.79, or about $0.006 per pound.

11. Miscellaneous Operating Expenses.

Taking down and storing plant	$223.05
Holidays	1,599.15
Fuel	994.95
Office expenses, including blue printing, telegrams, expressage, etc	1,018.64
Mileage	723.71
Advertising	39.60
Subsistence	762.40
Testing cement	87.00
Surveys	28.50
Total	5,477.00

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12. MISCELLANEOUS ITEMS IN BATTERY.

Road in rear of battery	$199.16
Ladders (five)	143.50
Drainage	441.47
Speaking tubes	45.10
Doors (twenty-one)	595.94
Plastering, painting, and whitewashing magazines	262.81
Placing base ring	164.25
Retaining walls	213.14
Total	2,065.37

The average cost of ladders and doors was, respectively, $28.70 and $28.38 each.

13. COST OF CONCRETE PER CUBIC YARD, IN PLACE.

(*a*) *Rosendale concrete.*

Forms	$0.71
15 cubic feet broken stone	1.88
15 cubic feet pebbles	1.71
5 cubic feet sand	.10
1¼ barrels cement	1.41
Supplying broken stone to mixer	.08
Supplying pebbles to mixer	.06
Supplying sand to mixer	.03
Supplying cement to mixer	.08
Supplying water to mixer	.01
Mixing	.17
Placing	.62
Total	6.86

(*b*) *Portland concrete.*—All the items will be the same as in the Rosendale concrete except cement, which was $2.39, making a total of $7.84 per cubic yard.

(*c*) *Louisville concrete,* $7.04 per cubic yard.

(*d*) *Paving and steps.*—The total amount expended for labor on 1,200 square yards of paving was $409.87, or $0.34 per yard.

Total cost per square yard:

One-eighteenth yard Portland concrete	$0.44
One-ninth yard Rosendale concrete	.76
Labor	.34
Total	1.54

The cost of steps was practically the cost of Portland concrete.

14. MAINTENANCE AND REPAIRS.

Sundry material	$390.65
General damage from storms	203.57
Wharf	558.96
Hoisting engines	16.80
Traveling derrick	61.50
Water supply	281.66
Rolling stock	274.90
Railroad	108.27
Locomotive	470.26
Lighters and boats	1,419.48
Mixer	202.48
General plant	408.48
Total	4,397.01

This head includes oil and waste and all necessary material for repairs. During the four months of active operation, running all day and night, four boilers and five engines used 160 gallons of cylinder oil, 246 gallons of black oil, and 890 pounds of waste.

In operating the lighting plant, 11 gallons of lard oil, 324 gallons of kerosene, and 842 gallons of gasoline were used. The total fuel consumed amounted to 340 cords of wood and 57 barrels of coal.

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SUMMARY.

Wharf	$9,947.94	
Railroad	7,142.87	
Incline and storage bins	2,270.21	
Concrete mixer	1,672.75	
Water supply	1,714.08	
Miscellaneous plant	13,568.40	
Total plant		$36,316.25
Materials for concrete	75,248.02	
Supplying material to mixer	3,544.54	
Mixing concrete	2,229.33	
Depositing concrete	8,042.66	
Forms	9,974.03	
Total cost of concrete		99,038.58
Steel beams	2,099.47	
Sand filling	12,323.12	
Miscellaneous operating expenses	5,477.00	
Maintenance and repairs	4,397.01	
		24,296.60
Clerical, superintendence, etc		4,805.25
Miscellaneous items for battery		2,065.37
Expenses from Montgomery office previous to April, 1896		2,142.21
Total		168,664.26

PLATFORMS.

The following is the approximate cost of platforms. It is impossible to give it accurately, as they were built at the same time as the other work, and the items can not be separated.

Cost.

1,000 cubic yards of Portland concrete	$7,840.00
600 cubic yards of Louisville concrete	4,224.00
400 square yards of paving	616.00
Anchorage bolts	540.00
Steel beams	500.00
Removing forms	76.11
Total cost of four plotforms	13,796.11

Average per platform, $3,449.03.

To this will be added cranes, ammunition hoists and conveyers, and cost of placing base rings.

BATTERY FOR EIGHT 12-INCH MORTARS.

Plans, estimates, and specifications have been submitted and returned for revision. A railroad to the site of the battery has been surveyed and partially constructed.

SUBMARINE MINES.

Plans and estimates of materials have been prepared and submitted.

Estimate for maintenance of new battery for 10-inch guns for year ending June 30, 1896.

One mechanic	$900
One helper	500
Two watchmen	960
Fuel	120
Oil, etc	90
Total	2,570

Respectfully submitted.

J. P. JERVEY,
Second Lieutenant, Corps of Engineers.

Maj. F. A. MAHAN,
Corps of Engineers U. S. A.

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Abstracts of bids received and opened on May 29, 1897, by Maj. F. H. Mahan, Corps of Engineers, for furnishing and delivering material for gun emplacements.

	Thos. Carlin's Sons, Allegheny, Pa.	Thompson C. Gill & Co., Philadelphia, Pa.	N. J. Foundry and Machine Co., New York, N. Y.	General Electric Company, Schenectady, N. Y.		Vulcan Iron Works, Chicago, Ill.	The Triumph Electric Co., Cincinnati, Ohio.	Whiting Foundry and Equipment Company, Harvey, Ill.
				Regular.	Alternate.*			
Class No. 1.								
One 16-H. P. boiler with base and fixtures and pipe connections complete		†		$300.00	$300.00			
One H. S. stationary engine and direct connected dynamo		†		1,150.00	900.00		$995.00	
Switch board and testing apparatus, complete		†		126.95	378.00			
One one-fourth H. P. blower and motor, complete		†		145.00	145.00		95.00	
Twenty-nine incandescent lamps, wire, etc		†		386.00	386.00			
One electric motor, complete		†		751.00	500.00			
One storage battery, complete		†		1,084.00	901.50			
Total				3,942.95	3,510.50		1,090.00	
Class No. 2.								
Two ammunition hoists, complete (each)	*$454.00	†	$892.50			$1,194.00		$636.10
Total	908.00		1,385.00			2,388.00		1,272.20

* Recommended for acceptance. On account of informality all bids rejected, by direction of the Chief of Engineers, United States Army.
† No price stated on bid.

Preservation and repair of fortifications.—Three concrete platforms with granite pintle blocks for 8-inch converted rifles were built to replace three timber platforms which had been so rotten as to become useless. The ammunition conveyors were also repainted.

Money statement.

July 2, 1896, amount allotted	$20.00
April 6, 1897, amount allotted	1,800.00
	1,820.00
June 30, 1897, amount expended during fiscal year	891.80
July 1, 1897, balance unexpended	928.20
July 1, 1897, outstanding liabilities	928.20

3 P.

DEFENSES OF MOBILE AND MISSISSIPPI SOUND.

Officer in charge, Maj. William T. Rossell, Corps of Engineers; assistants, Lieut. Harry Burgess, Corps of Engineers, to September 24, 1896, and Lieut. James B. Cavanaugh, Corps of Engineers, since September 27, 1896; Division Engineer, Col. Peter C. Hains, Corps of Engineers.

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Shore protection.—By letter of Chief of Engineers dated September 5, 1896, $5,000 was allotted from appropriation for "Preservation and Repair of Fortifications," act of June 16, 1896, to be expended in shore protection at Forts Morgan and Gaines.

By letter of Chief of Engineers dated March 22, 1897, $20,000 was allotted from appropriation for "Sea Walls and Embankments," act of March 3, 1897, to be expended in shore protection at Forts Morgan and Gaines.

Authority was obtained to expend the first allotment at Fort Gaines, and also as much of the second allotment as may be necessary to complete the work there before any work is undertaken at Fort Morgan.

A contract was entered into with W. Chase Spotswood on March 27, 1897, for the construction of a sea wall 1,000 feet long, and six groins, each 150 feet long, both sea wall and jetties to be composed of a riprap wall with hand-laid slopes of heavy stones, founded upon a fascine mattress 30 feet wide. Work was to commence upon sea wall and to be limited by the funds available. Under this contract 493 feet of sea wall was completed, and for 44 feet additional the mattress was sunk and wall partially completed.

June 15, 1897, supplemental contract was entered into with W. Chase Spotswood for the completion of the shore protection at Fort Gaines, the sea wall to be done on or before November 1, 1897, and the groins on or before July 1, 1898.

The expenditures during the fiscal year have been as follows:

1,790 square yards fascine mattress	$2,506.00
762 cubic yards stone	2,438.40
Labor	20.50
Printing, mileage, etc	18.64
Total	4,983.54

Fence.—By indorsement of Chief of Engineers, dated March 25, 1897, $850 was allotted from appropriation for "Preservation and Repair of Fortifications," act June 6, 1896, for the construction of a fence on the eastern boundary line of Fort Morgan Reservation. Under this allotment a substantial barbed-wire fence 3,350 feet long, from Mobile Bay to the Gulf of Mexico, has been built, at a total cost of $619.78. The ends of the fence on the north and south beaches are difficult to maintain and will require modification to prevent stock passing round them.

Repair of platforms.—By letter of Chief of Engineers dated June 14, 1897, $3,000 was allotted from the appropriation for "Preservation and Repair of Fortifications," act of March 3, 1897, for repairing platforms for 8-inch converted rifles and other most necessary work included in estimate submitted December 21, 1896. In addition to repairing platforms, the funds will be sufficient to clean out cisterns, to clean ditch and restore drainage of same, and to repair and rebuild necessary fences.

Money statement.

June 30, 1897, amount allotted		$28,850.00
June 30, 1897, amount expended during fiscal year		5,636.56
July 1, 1897, balance unexpended		23,213.44
July 1, 1897, outstanding liabilities	$44.22	
July 1, 1897, amount covered by uncompleted contracts	14,000.00	
		14,044.22
July 1, 1897, balance available		9,169.22

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Abstract of proposals for construction of shore protection at Fort Gaines, Dauphin Island, Alabama, opened March 3, 1897.

Name and address of bidder.	Fascine mattress in place, per square yard.	Stone in place, per cubic yard.
W. Chase Spotswood, Mobile, Ala	$1.40	$3.20

Contract is in force.

With W. Chase Spotswood, for building and completing fascine mattresses, sea wall, and jetties at Fort Gaines, Ala., approved June 23, 1897, work beginning July 1, 1897, and to be completed by the 1st day of June, 1898.

Needful casemate and cable gallery.—At the beginning of the fiscal year the casemate and cable gallery were completed, with the exception of grading and sodding the slopes of the casemate. During the fiscal year these slopes were graded and sodded with Bermuda grass, completing the work. The sod was lifted and transported in wheelbarrows by means of an extemporized cableway operated by one of the small hoisting engines, all work being done by hired labor.

Cable tank.—May 13, 1897, by indorsement of Chief of Engineers, an allotment of $4,000 was made for construction of cable tank. Plans for same have been prepared and materials contracted for. The lumber for cable-tank house has been received and stored.

The application of the funds during the fiscal year was as follows, superintendence and subsistence being included in the cost of the different items:

Grading casemate slopes	$32.95
Sodding casemate slopes	445.98
Fertilizer	18.00
Plant	24.51
Lumber for cable-tank house, including transportation	394.12
Unloading lumber for cable-tank house	34.30
Total	949.86

Money statement.

July 1, 1896, balance unexpended	$695.71
June 30, 1897, amount allotted during the year	4,675.00
	5,370.71
June 30, 1897, amount expended during the fiscal year	876.93
July 1, 1897, balance unexpended	4,493.78
July 1, 1897, outstanding liabilities	566.22
July 1, 1897, balance available	3,927.56

Battery for 8-inch guns mounted on disappearing carriages.—The approved project provides for the construction of a four-gun battery for 8 inch guns mounted on disappearing carriages, at an estimated cost of $275,000. Emplacements and platforms 1 and 2 are for carriage model 1894, and emplacements and platforms 3 and 4 for carriage model 1896.

The total of the allotments thus far made for the construction of the battery is $182,500.

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PROGRESS OF THE WORK.

Emplacement 1.—The concrete work of the emplacement is completed, except a small retaining wall in rear of the wing wall of the battery, across the site of which the railroad now runs. One thousand nine hundred and eight cubic yards of sand have been placed in the parapet. There still remains to be done the completion of the sand filling and all work of grading, paving, revetting, etc., connected therewith. Also the erection of trolley beams and the construction and hanging of permanent doors to magazines.

Platform 1.—The platform proper is completed, ready for the gun, with the exception of the base ring and traverse circle, which have not yet been received from the Ordnance Department. In addition to setting this ring and circle, there remains to be done the erection of trolley beams and circular stairways and the construction and hanging of permanent doors to shot chamber.

Emplacement and platform 2.—The concrete work of emplacement is completed, and 3,472 cubic yards of sand have been placed in parapet.

There remains to be done the sand filling and all work of grading, paving, revetting, etc., connected therewith; the erection of trolley beams and the construction and hanging of permanent doors to magazines.

The platform proper is completed and ready for the gun, with the exception of the base ring and traverse circle, which have not been received from the Ordnance Department. In addition to setting this ring and circle there remains to be done the erection of trolley beams and circular stairways and the construction and hanging of permanent doors to shot chamber.

Emplacements and platforms 3 and 4.—All the concrete work of emplacement 3 is complete, except the granolithing of the superior slope and the lift platform. No other work of construction has yet been done. The concrete work on emplacement 4 is completed, except 995 cubic yards, including the granolithing of the superior slope and lift platform. No other work of construction has yet been done.

The foundation of platform 3 has been prepared by filling with sand, wetting and tamping same; 91.75 cubic yards of concrete have been placed. Work on platform 4 has been confined to the foundation, putting in a part of necessary sand filling.

OPERATIONS DURING FISCAL YEAR.

Emplacement 1.—During the year the concrete work of the emplacement was completed and superior slope granolithed; 599.1 cubic yards of concrete were placed, including 645 square yards of granolithing; 1,908 cubic yards of sand were filled in parapet by means of wheelbarrows; trolley beams and trolleys were received and stored, ready for erection. Total expenditures during the year have been $5,189.23.

Platform 1.—During the year the platform was completed. One hundred and forty cubic yards of sand were placed in foundation; 272.8 cubic yards of concrete were placed, including 239 square yards of granolithing, and 9,500 brick were laid in rear wall of shot chamber and in facing rear surface of platform. All accessories, such as cranes, trolleys, and iron stairway, have been received and stored, ready for erection. Total expenditures during the year have been $3,892.84.

Emplacement and platform 2.—July 15, 1896, an allotment of $48,500 was made for the construction of a second emplacement and platform. During the year the masonry work of the emplacement was completed; 4,632.2 cubic yards of concrete, including 457 square yards of granolithing, were placed; 1,132 cubic yards of sand were excavated from

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foundations, and 3,472 cubic yards of sand placed in parapet. Trolley beams and trolleys were received and stored, ready for erection.

The platform was practically completed during the year, its construction preceding that of the emplacement. One hundred and twelve cubic yards of sand were excavated from foundations, and 311 cubic yards refilled, wetted, and tamped. Three hundred and forty-four cubic yards of concrete, including 239 square yards of granolithing, were placed. Nine thousand five hundred brick were laid in rear wall of shot chamber and in facing rear surface of platform. All accessories, such as cranes, trolleys, iron stairways, etc., were received and stored, ready for erection.

A cement shed 90 by 41.5 feet was constructed to avoid damage to cement due to storage in casemates. Total expenditures on emplacement and platform during the year have been $43,113.82.

Emplacements and platforms 3 and 4.—December 10, 1896, an allotment of $70,000 was made for completing the two remaining emplacements of the battery as far as funds would permit. The emplacements and platforms to be of the modified type, to receive the disappearing carriage, model 1896.

Plans and projects for the work were prepared and approved. Additional plant, consisting of one small locomotive, half mile railroad track, 40-pound rail, materials for eighteen new tram cars, two Lidgerwood hoisting engines, one steam pump, and the necessary tools, etc., were purchased and installed. Old plant was thoroughly overhauled and a gravel derrick built. Materials were contracted for, received, and stored.

The masonry work of the third emplacement has been completed, except granolithing the superior slope and lift platform. Two hundred and ninety cubic yards of sand were filled in foundations, and 4,162.9 cubic yards of concrete, including 125 square yards granolith surface, were placed.

The masonry work of the fourth emplacement has been completed, with the exception of 995 cubic yards, including granolithing of superior slope and lift platform.

The foundations of platform 3 have been prepared by excavating 335 cubic yards of sand and refilling 205 cubic yards; 91.8 cubic yards concrete have been placed in front wall of shot chamber and walls of small room under platform.

Work on platform 4 has been confined to the foundations, in which 120 cubic yards of sand have been placed. Total expenditures on the two emplacements and platforms during the year have been $52,983.03.

The application of the funds during the fiscal year for the entire battery has been as follows:

Pay rolls	$29,102.10
Provisions	4,944.45
Horse hire	698.84
Cement	24,368.78
Gravel	25,880.90
Stone	2,484.51
Brick and sewer pipe	136.50
Lumber	2,285.02
Tools, hardware, supplies, etc	2,217.13
Plant	5,825.32
Whitehall boat, complete	150.00
Transportation, including share of expenses of steamer *Maud* and naphtha launch	2,834.29
Mileage	107.95
Printing, stationery, furniture, and incidentals	348.40
Total	105,178.92

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Deducting from the total expenditures as above, the value of metarials on hand July 1, 1897, as follows,

1,330 barrels Portland cement, tested and stored, at $2.12⅝	$2,830.24
1,701½ cubic yards gravel, stored, at $2.55	4,338.83
200 cubic yards rock, stored, at $2.18½	436.20
Plant, practically new	5,131.22
Boat	150.00
	12,886.49

the total expenditures properly chargeable to the year's operations are found to be $92,292.43, with which the following work was done,

1,679 cubic yards sand excavation, at 15 cents	$251.85
1,330 cubic yards sand filling in foundations, including wetting and tamping, at 30 cents	399.00
5,380 cubic yards sand filling in parapet	1,291.20
19,000 brick laid, labor and materials, except 9,500 brick	440.09
Cement warehouse, labor and materials	1,197.25
12,510 cubic yards concrete, including 1,856 square yards granolith surface, at $7.09½	88,713.04
	92,292.43

Money statement.

July 1, 1896, balance unexpended	$15,480.52
July 15, 1896, amount allotted	48,500.00
December 10, 1896, amount allotted	70,000.00
	133,980.52
June 30, 1897, amount expended during fiscal year	105,178.92
July 1, 1897, balance unexpended	28,801.60
July 1, 1897, outstanding liabilities	818.74
July 1, 1897, balance available	27,982.86

Abstracts of proposals for furnishing American Portland cement, gravel or crushed stone, and stone ballast, opened February 11, 1897.

Name and address of bidder.	Cement.			
	Brand.	Barrels.	Rate.	Amount.
Atlas Cement Co., New York City	Portland	1,500	$2.06	$3,090
A. C. Danner, Mobile, Ala	American Portland	1,500	2.45	3,675
	Lagerdorfer	1,500	2.50	3,750
Chas. Clarke & Co., Galveston, Tex	American Portland	1,500	2.50	3,750
	English Portland	1,500	2.82	4,230
E. Wallis & Co., Baltimore, Md	American Portland	1,500	3.00	4,500
John Strachan Barret, Mobile, Ala	do	1,500	3.25	4,875

Name and address of bidder.	Gravel or crushed stone.					Stone ballast.		
	Cubic yards.	Rate.	Amount.	Rate.	Amount.	Cubic yards.	Rate.	Amount.
Rittenhouse Moore Dredging Co., Mobile, Ala	5,000			$2.20	$11,000	$1,000	$1.80	$11,800
W. Chase Spotswood, Mobile, Ala	5,000	$2.40	$12,000			1,000	2.00	2,000
Chas. Clarke & Co., Galveston, Tex	5,000	2.95	14,750	3.55	17,750	1,000	2.35	2,350
J. M. Walsh, Mobile, Ala	5,000	2.48	12,400					

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Abstracts of proposals for furnishing cement, gravel or crushed stone, and broken stone, opened August 26, 1896.

Name and address of bidder.	Cement.					
	Portland.			American natural.		
	Barrels.	Rate.	Amount.	Barrels.	Rate.	Amount.
Lawrenceville Cement Co., New York, N. Y.				7,000	$1.327	$9,289
John Strachan Barret, Mobile, Ala	1,050	$2.85	$2,992.50	7,000	1.337	9,359
A. C. Danner, Mobile, Ala	1,050	2.65	2,782.50			

Name and address of bidder.	Gravel.			Crushed stone.			Broken stone.		
	Cubic yards.	Rate.	Amount.	Cubic yards.	Rate.	Amount.	Cubic yards.	Rate.	Amount.
Chas. W. Hogan, Mobile, Ala	5,800	$2.44	$14,152						
W. Chase Spotswood, Mobile, Ala	5,800	2.66	15,544				300	$2.50	$750
Frank Ward, Mobile, Ala	5,800	2.80	16,240	5,800	$2.80	$16,240	300	2.50	750

3 Q.

DEFENSES OF NEW ORLEANS, LOUISIANA.

Officers in charge, Maj. J. B. Quinn, Corps of Engineers, to September 15, 1896, and since June 14, 1897; Lieut. C. S. Riché, Corps of Engineers, from September 15, 1896, to June 14, 1897; Division Engineer, Col. J. W. Barlow, Corps of Engineers, until May 7, 1897; Col. H. M. Robert, Corps of Engineers, after that date.

Two emplacements for 10-inch guns, disappearing carriages.—The land in this locality is marshy and unsuited to the construction of the modern form of battery, and it is further significant of the situation that the armament and character of the defenses existing at this place were, in 1862, when Farragut successfully passed up the river and captured New Orleans, far more formidable, relative to the ships of war then extant, than any development of the approved modern appliances possible of application at the locality under existing conditions. This gives to the locality the reputation of impracticability for a successful point of defense of the approach to New Orleans and the control of the grand artery of commerce of an empire in extent.

There is no uninterrupted land communication with any point of supply. New Orleans, La., is the nearest point from which supplies can be drawn.

The New Orleans, Fort Jackson and Grand Island Railroad terminates at a point on the opposite side of the river about 5 miles distant. A small steam launch makes communication with the morning train and will stop at the work to deliver small packages or to take on passengers. A small steamboat makes semiweekly trips between New Orleans and the work. The nearest post-office is Neptune.

COMMENCEMENT OF WORK.

Under the allotment of March 8, 1895, preparations were carried on upon plans approved by the Department, and little was accomplished beyond the preparation of detailed working plans, perfection of con-

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tracts for delivery of material, erection of wharfage and buildings for reception of materials and accommodation of laborers, accumulation of working plant, and partial completion of pile grillage for the north emplacement.

The grillage was finished in July, 1896, but owing to delay on the part of the contractors to deliver materials promptly the concrete work could not begin until August 17, from which date till September 15, 1896, the work was pushed with two shifts of men, and from September 15 to 19 with one shift, after which active operations were practically suspended owing to the fact that instructions as to continuance involved a complete change in plans and material reductions in the estimated cost of completion, all of which involved the preparation of new plans and readjustment of quantities and modification of previously supposed established methods of construction and detail, all of which, from the very nature of things, were prohibitive of further advance until these matters could be settled. In addition to all this unexpected obstacle to progress there was the added obligation to complete the work within four months, obviously an impossibility at the locality, under the conditions involving the delays incident to the approval of modifications in original plans made necessary by the new conditions imposed.

In response to my assertion that the contemplated battery could not be completed within the specified time, or for the money allotted for this work if the original plans were to be adhered to, I was relieved of further charge and transferred the work to First Lieut. C. S. Riché, Corps of Engineers, on September 21, 1896, under whose personal supervision the work continued until June 12, 1897, at which time the charge was returned to me. .

Upon Lieutenant Riché assuming charge the revision of plans and estimates was completed and the allotment of July 6, 1896, of $55,000 was increased to $90,000, and material reductions made in the quantities of concrete to be used and the character of the supporting grillages beneath the masonry. Active operations were commenced November 24, 1896, and by January 12, 1897, the foundation was completed and the concrete work resumed. By March 1, 1897, the greater part of the concrete work was completed, and the earthen part of the parapet was completed by April 10, 1897.

The concrete parapet and the platforms having settled out of shape, some further work was required to surface up the work and to bring the platforms back to a level, the experiment of loading them with shot was tried.

As the subsidence of the entire work is still in progress, it is doubtful if the results obtained by weighting the platforms has equaled expectations.

The ironwork for loading platforms and trolleys was delivered between May 13 and May 28, and with an exception of the hoisting cranes and steps to platforms was practically all in place by June 19, 1897. As the guns were soon expected, the completion of the platforms was expedited, and some attempts, not as yet completed, made to raise floors of magazines and reconstruct the drainage, all of which had been seriously disarranged by the excessive subsidence of the masonry. The battery is not therefore finished at the end of the fiscal year, and a further allotment will be necessary to complete it as contemplated at the time Lieutenant Riché transferred the work to me.

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METHOD OF DOING THE WORK.

Under the first allotment for commencement of the work upon the battery, specifications were prepared and recommendations made that the work be done by contract, but this recommendation was disapproved for the reason that it would give undue publicity to the particulars of the construction, which was not considered to be to the interests of the Government, and, consequently, instructions were given to conduct the work by hired labor. This method involved the purchase of a complete working plant, and while greatest efforts were made to keep the cost of this plant within the narrowest limits, the subsequent instructions to hasten the work to an exceptional degree involved an investment which Mr. Miner, the assistant engineer, reports in detail as amounting to, including labor and contingencies for installation, $28,829.57. This includes new buildings, repairs to old buildings, wharves, mess furniture, tools, cement mixers, pile drivers and all appliances used in the prosecution of the work.

THE FOUNDATION.

The soil being very compressible at the point selected for the erection of the new type battery, it was, from the very beginning, a subject for speculation whether the structure could be made to stand. I made a thorough investigation of all the methods in use in the vicinity for the support of structures of any magnitude and there was not a single example which had not failed to support a load far less than that required in this case under consideration.

Borings had been made near by for the proposed canal between the Mississippi River and the Gulf, but little information could be gained rom these investigations beyond the fact that the material was mud. It was hoped that by driving piles to a considerable depth the compression of the substrata which might be met would afford sufficient support, and if the piles were driven at such distances apart as to develop the full frictional effect a sufficient area of foundation might be secured to bear up the mass of masonry.

In order to distribute the weights as uniformly as possible a pile grillage was recommended, the piles to be 60 feet long, to be spaced 3 feet 6 inches from center to center, and to be capped with 12 by 12 inch timbers and crossed with a flooring of 12 by 12 inch timber.

The grillage was given a liberal projection beyond the foot of the masonry.

In order to present a thorough exhibit of the character and behavior of the pile grillage, I will introduce in full Mr. Miner's report:

REPORT OF MR. C. A. MINER, ASSISTANT ENGINEER.

The foundations for the north emplacement consist of 944 60-foot piles, with caps and grillage constructed of 12 by 12 inch timber. Those of the south emplacement consist of 640 30-foot piles, without grillage. Those of each of the gun platforms consist of 216 60-foot piles driven vertically, and 54 35-foot piles driven in three rows at the rear part of the gun platform on a batter of 1 in 2, the points radiating away from the counterweight well, their purpose being to resist the concussion of the gun. On these is placed a grillage consisting of caps and a flooring of 12 by 12 inch square timber.

The foundations of the guns and parapets were carefully kept separate, according

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to recommendation of The Board of Engineers in one of their confidential letters In fact, it would have been impracticable to do otherwise, especially on the north emplacement, for there was not a plan sent to this office showing the Board's designs for gun platform till the foundations for the north emplacement were well under construction. It was hoped that by keeping the foundations separate whatever tendency to settlement there might be in the superior weight of the concrete parapets or the concussion of the gun might be free to act on its own foundation without affecting the levels of those adjoining.

The piles were driven with a Vulcan steam hammer weighing about 4,600 pounds net, and 9,000 pounds including the cylinder and frame, which was a dead weight resting on the pile while being driven. They were driven nearly their whole length in the ground, then, by means of a follower, to a depth of 3 to 4 feet under the surface. The follower was protected at the head with a heavy ring and at the foot with a casting having a cone-shaped inner surface which fitted neatly over the head of the pile. While the piles were being driven they would apparently recoil slightly after each stroke, and the ground within a radius of 200 or 300 feet would tremble. The piles would run under the weight alone of the hammer 15 to 18 feet; at a depth of 27 to 28 feet they entered a stratum of earth about 5 feet thick that offered more resistance to the piles than any found above or below it until a depth of 50 feet was reached.

Pile driving on the north emplacement was commenced on the front or river side and proceeded backward in successive rows lengthwise of the battery. It required 110 to 140 strokes of the hammer to drive each pile in the first row down to the level of the ground. But as row after row was driven the driving gradually became harder until about half of the piles were driven, when it required 200 to 330 strokes per pile. After this there was no apparent increase except at one place on the back rows where a few interior piles were left till all the piles surrounding them had been driven, in which case the driving became much harder, requiring from 400 to a maximum of 600 strokes. Tests showed that the bearing power in all cases was nearly proportional to the number of strokes required to drive; also that the resistance to driving began to increase with each pile very soon after driving ceased and continued to increase indefinitely. Attempts were made to further drive several piles which had been allowed to rest from sixteen to forty hours after being driven nearly to the surface of the ground, with the result that the penetration for each stroke was only one-third to one-twentieth as great as at the time of driving, and in three of these the pile heads or follower were driven to destruction without producing any perceptible penetration.

After the pile driving for north emplacement was nearly completed it was found necessary to lengthen the battery to provide for a gun platform 62 feet wide instead of 55 feet wide, as shown on the earlier plans. Accordingly, two more rows of piles were driven across the northeast end. Below are given the computations for bearing power of ten piles in those rows, taken at the time of driving.

Tests were made by Trautwine's formula, P (= bearing power, ultimate) $= \sqrt[3]{\frac{h W \times .0268}{1+a}}$; by the Engineering News formula, P (ultimate) $= \frac{f w h}{s+1}$, and by Sanders's formula, P (safe) $= \frac{H}{a} \times \frac{w}{8}$. When the constant f in the Engineering News formula was taken $= 2$, which is the value recommended to assume for this class of soil, the resulting value of P was the same as obtained by Trautwine's formula.

Pile.	Bearing power.	
	Ultimate. *a*	Safe. *b*
	Tons.	*Tons.*
1	102	14.6
2	128.7	28.1
3	82.7	9.5
4	103.5	15.2
5	97	13.1
6	103	15
7	89.2	11
8	117	20.8
9	82.7	9.4
10	104.1	15.4
Average	101	15.2

a Trautwine's formula; Engineering News formula. *b* Sanders's formula.

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Three of these piles were also tested at a depth of about 30 feet with the following results:

Pile.	Bearing power.	
	Ultimate. *a*	Safe. *b*
	Tons.	*Tons.*
1	54	4.8
2	82	9.4
3	50	4.3
Average	62	6.2

a Trautwine's formula; Engineering News formula. *b* Sanders's formula.

Little reliance was placed on these values on account of the apparent increase in bearing power after being driven for some time and the apparent increase in resisting power of the soil as it gradually became filled with piles. When foundations for the south emplacement were designed it was believed that 30-foot piles left with the points in the compact stratum at that depth would give sufficient bearing power. The piles were driven in transverse rows beginning at the north emplacement. There was no apparent change in the bearing power of the soil as the driving proceeded for this emplacement. No grillage was used, the pile having been driven only under the concrete. I-beams were used underneath the rooms and passages to distribute the weight uniformly over these piles and prevent them from pinching up through the floors in case settlement should take place. In constructing the concrete work great care was taken to separate the two emplacements and the parapets from the gun platforms, using tarred paper partitions to prevent binding of concrete surfaces, so that either mass might be free to settle independently of the other.

In February, 1897, it was observed that settlement was taking place everywhere. Careful levels have been taken at regular intervals ever since, and a table* is herewith appended showing the nature of this settlement.

From the nature of the formulas for bearing power of piles and the method of their application it is evident that, even if reliable, they would only indicate the frictional resistance of the earth on the surfaces of the piles; they would not indicate the resistance of the earth surrounding the piles to compression or settlement. The total load on the foundations of the north emplacement is 10,800 tons concrete and 3,500 tons earth, making a weight of 15.2 tons per pile. Total load in the south emplacement is 9,500 tons concrete, or 15 tons per pile. Although the ultimate bearing power given by the formulæ generally accepted as reliable is from four to seven times this amount, settlement has taken place. In any *rational* formula for bearing power of piles the amount of frictional surface of the pile would be a very important element. It is possible when settlement of a piled foundation takes place that it may be due not to the fact that the friction of the earth against the surfaces of the pile has been overcome and sliding has taken place, but that, after compression of the mass has gone to a certain extent due to the driving of piles, the entire mass begins to act as a single pile and to settle en masse; and when that point is reached any further filling of the earth mass by driving piles will have no effect in adding to the bearing power of the foundation. It would seem that this limit would never be reached until the sum of the circumferences of the piles driven should be as great as the total circumference of the mass of piled earth, but might be reached at any time after this sum exceeded the circumference of the mass of piled earth. This sum of the circumference of the piles in the north emplacement, assuming them to have an average diameter of 14 inches, is 3,460 feet, which is about eight times the perimeter of the foundation. It is believed that this excess is too great; that just as good a foundation could have been made in the same area by driving less piles; that if foundations of greater bearing power are desired they should, in this soil, be obtained by increasing the length of the piles and the area of the foundations rather than driving piles too thickly; that it is a safe rule to limit the sum of the circumferences of the piles to twice the perimeter of the foundation. If this had been done, only one-quarter as many piles would have been driven in the north emplacement, placing them 7 feet apart instead of 3½ feet.

Settlement has taken place by the mass of piled earth beneath and for some distance surrounding the grillage having settled. This is evident, (1) because the piles that had been driven and sawed off to level in the north gun platform near the parapet when the foundations for parapet were built were observed to have settled

* Omitted.

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nearly the same as the parapet foundations, though no weight had as yet been placed on them; (2) because the gun platforms have settled only on the side next the parapet, leaving them tilting forward.

Levels have been taken which show that the old fort, placed on a grillage foundation without piles, has settled, and quite unevenly. Also, that the magazines of the water battery have settled from 1.5 feet to 3 feet, some of them settling entirely out of level.

Experience with foundations at this place leads me to the following conclusions:

1. It is impracticable to build foundations for heavy structures at this place that will not settle.

2. Foundations should always have a stiff, strong grillage to prevent concentrated loads from producing local settlement.

3. Care should be taken in building the superstructure to distribute the weight uniformly over the foundation, to have the weight symmetrical with the foundation, and its center of gravity at the center of foundation.

4. With the type of battery now under construction, one emplacement, including gun platform, concrete parapet, and magazines, should in all compressible soils be placed on a single foundation.

5. Each structure with its foundation should, in this place, be isolated from every other structure and foundation sufficient distance, so the influence of the piles in compacting the soil will not extend to the other foundation and affect it unequally.

6. There should be no weights contiguous to those resting on the foundation unless they can be placed symmetrically with reference to the foundation. Otherwise the effect of their weight may cause unequal settlement.

7. This is an unfortunate soil on which to build emplacements of the type now being constructed, or the type of emplacement is unfortunate for this soil; for, the influence of the earth parapet, which is situated on only one side of the foundation, is liable to cause unequal settlement. As this soil acts like a semifluid, the same care should be taken, and to a certain extent the same principles applied, in building a structure on a foundation as would be in loading a barge or ship.

The total cost for material and labor for the parapet grillage is given by Mr. Miner as $22,264 04, and the two-gun platform grillage cost $5,400; total, $27,664.04.

THE SUPERSTRUCTURE.

Mr. Miner's report upon the method of carrying on the concrete work and the details of cost are here presented in full, since I believe the matter to be of interest:

REPORT OF MR. C. A. MINER, ASSISTANT ENGINEER.

Forms.—The construction of forms for the north emplacement was begun about August 1, 1896, and was well under way before concrete work was begun on the 17th. Consequently a force of four carpenters was sufficient to keep always in advance of the work. But when concrete construction was resumed, January 12, 1897, at the rate of 200 yards per day, it required a force of seventeen carpenters to keep in advance of the work.

Forms were constructed of 4 by 6 inch timbers for upright posts and braces, 2 by 12 inch dressed lumber for surfacing on exposed plane surfaces, 1 by 12 inch dressed lumber on exposed curved surfaces, and 1 by 12 inch rough lumber on most surfaces to be subsequently covered with earth. Considerable trouble was experienced in obtaining sufficient bracing in the soft earth. At the foot of a row of braces was built, to a depth of 2 to 4 feet below the surface, a continuous mudsill, against which the braces were firmly set perpendicularly. As one part of the battery was built up before another was begun, we were enabled to use the same timber for forms in different parts of the work. The forms were not put up in sections, but had to be demolished and rebuilt. Posts were placed in an upright position and surfacing horizontal, curves included, except on the forms for counterweight wells, where the curvature was so sharp that it was deemed best to surface them with 2 by 4 inch timbers placed vertically.

The cost of forms was as follows:

Materials	$1,799.14
Labor	3,586.38
Total	5,385.52

This is 49 cents per yard for the concrete made.

Concrete.—Materials for making concrete began to arrive in July, 1896, but sand and rock had not been delivered so that construction work could begin before the

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middle of August. After that time concrete construction proceeded so rapidly that the contractors were unable to furnish the materials as rapidly as they were required, partly due to the fact that on account of the extreme heat they were compelled to suspend work at the quarry for several weeks. By September 19, 1896, the supply of gravel and rock was exhausted, and concrete work was suspended.

The difficulties experienced up to this time in obtaining materials as needed served as a warning that in order to complete the battery by February, 1897, as ordered, or even to approach any near stage of completion, it would be necessary to have all materials purchased by the most expeditious methods—methods, in some cases, that were rarely permitted by the Government—and the delivery of nearly all materials before construction work was resumed. All foundation materials were delivered before construction of foundations for the second emplacement was begun, and all materials for the rest of the concrete work was delivered before work on the superstructure was resumed.

The concrete for the parapets was mixed nearly in the proportions of 1 cement, 3 sand, 8 gravel or crushed rock; that of the gun platforms nearly in the proportions of 1 cement, 2 sand, 5 gravel or crushed rock, and 2 large rock. On all exposed surfaces a layer of concrete about 3 inches thick, that consisted of sand and cement only, in the proportion of about 3 to 1, was laid against the forms just as the body of the concrete was built, the two being tamped so as to form a perfect bond. After the forms were removed all exposed surfaces were further finished with a coat of mortar made in the proportion of 1 cement to 1 sand.

The sand, gravel, crushed rock, and large rock were purchased by contract, dated March 17, 1896, with Joseph Edward Crusel, of New Orleans, La., and by two supplemental contracts, dated September 21 and November 2, 1896, also with Joseph Edward Crusel, for rock, sand, etc. The following amounts were obtained and at the prices given:

Sand:	
Original contract, 2,101.81 yards, at $1.50	$3,152.72
Supplementary contract, 2,478.53 yards, at $1.40	3,469.94
Total, with average price, 4,580.34 yards, at $1.446	6,622.66
Gravel, original contract, 4,291.93 yards, at $3.23	13,862.94
Large rock, original contract, 532.77 yards, at $3.23	1,720.85
Crushed rock, original contract, 65 yards, at $3.23	209.95
Gravel, supplementary contract, 6,817.13 yards, at $2.20	14,997.71
Total, with average price, 11,706.83 yards, at $2.65	30,791.45

The sand and gravel were obtained from Prophets Island, Mississippi River, near Natchez. It is a hard, durable quality of limestone. The first shipment of large rock was of limestone obtained from quarry in Mississippi. The contractors installed a plant for crushing such portion of this as would be required. Sixty-five yards of it were crushed, but lay for several weeks exposed to weather before using. It was observed to have disintegrated badly, and no more of it was used. Gravel was substituted.

In making concrete no attempt was made to mix crushed rock and gravel. The next and last shipment of large rock that was made was granite ballast. In addition to the large rock purchased there was used 700 yards of old granite pintle blocks and cut stone which had been at the site for many years. This large rock was all placed in the parapets and traverse, none being used in the gun platforms. Most of it had to be blasted and broken in small pieces, after which it was transported by wheelbarrows to the work, a distance of 300 to 500 yards.

The cement used in the battery was entirely German Portland. The varying degrees of strength of concrete required in different parts of the structure were obtained by varying the proportions of cement. It was all obtained from the National Building Supply Company, of Baltimore, Md., by contract dated April 13, 1896, and supplemental contract dated November 2, 1896. Only two brands were used, viz, "Kaiser," 4,400 barrels, and "Porta," 6,600 barrels. These brands were about equal in quality and were equal in cost.

The following table gives the amount and prices of cement purchased:

Contract.	Cement.	Price.	Total.
	Barrels.		
Original	4,800	$2.55	$12,239.00
Supplemental	700	2.45	1,715.00
Do	5,500	2.20	12,100.00
Total and average cost	11,000	2.3686	26,054.00

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Under the supplemental contract arrangements were made so that the contractors could unload cement at the work, without taking it to New Orleans and reshipping it. This was an apparent saving of 35 cents per barrel. The wharf was not large enough to permit the landing of ocean steamers; hence two barges were obtained from the Mississippi River Commission department at New Orleans and used for temporary wharf.

The cement purchased under supplemental contract was all delivered in three lots, the first 700 barrels coming from New Orleans, 2,500 barrels obtained from the steamer *Australia* December 25, 1896, and 3,500 barrels obtained from the steamer *Straits of Magellan* December 30, 1896. Having so much cement delivered before concrete construction was commenced necessitated the purchase of many tarpaulins and considerable lumber to enable it to be safely stored. It was mostly stored on top of the sand and gravel. As the time of arrival of the steamships could not be definitely foretold, it was necessary to keep a large force of men employed, and at a great disadvantage, for about three weeks, so that the steamships could be unloaded without unnecessary delay, which was one of the provisions of the contract. All of these items added greatly to the expense, probably enough to equal the apparent saving in the price per barrel. It was a saving in time, however, giving assurance of abundance of material for the most rapid work.

The other materials purchased for use in making concrete are as follows:

Granite lintels	$60.00
4,000 hollow tile, for air passages	579.00
Tarred paper, for planes of weakness	109.90
Total	748.90

Not all of the materials purchased have been used. There are on hand, available for use in any future construction work, about 650 cubic yards gravel, 400 cubic yards sand, 360 barrels cement, and 2,000 tile. The materials actually used and their values, estimated from the average unit prices paid, are given in the following table:

Cement, 10,660 barrels, at $2.37	$25,264.20
Gravel and rock, 11,056.83 yards, at $2.63	29,079.46
Old granite, 700 yards.	
Sand, 4,180.53 yards, at $1.446	6,045.05
Granite lintels	60.00
2,000 hollow tile, at 14.5 cents	290.00
Tarred paper	109.90
Total	60,848.61

The number of yards of concrete laid is 11,000; the average price of materials per yard is $5.5317. The labor of making and laying the mass of concrete in the platforms and parapets, having all the materials in bins at hand, was estimated to be $1.06 per yard. But the entire item of labor, including subsistence, in making and laying concrete, unloading, storing and handling materials, transporting old rock to site, building steps, finishing surfaces, etc., amounts to $23,104.05 to the end of the fiscal year, which is $2.10 per yard for the concrete laid. Total cost of concrete, labor, and materials is $7.63 per cubic yard.

The average number and distribution of a force of men for making and laying concrete, when working to full capacity, and the cost of labor, are given below:

Making concrete:	Per day.
1 foreman	$2.50
14 laborers, at $1, wheeling materials to mixer	14.00
6 laborers, at $1.50, handling cement barrels, cement, concrete boxes, water, derrick, and mixer	9.00
1 engineer, at $2, managing engine and mixer	2.00
1 fireman, at $1.50, managing engine and mixer	1.50
8 laborers, at $1, pushing cars	8.00
2 laborers, at $1.50, managing track	3.00
Total, 33 men	40.00

Laying concrete:	
1 foreman	2.50
8 laborers, at $1, handling cars and unloading	8.00
12 laborers, at $1, shoveling and placing concrete	12.00
15 laborers, at $1, tamping concrete	15.00
3 laborers, at $1.50, unloading cars	4.50
2 laborers, at $1.50, swinging derrick	3.00
1 fireman	1.50
1 engineman	2.00
Total, 43 men	48.50

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When the distance of materials from the mixer became greater, the number of men wheeling materials had to be increased to 21. The above distribution of men was always subject to changes depending upon conditions. This force of men could make and lay 1.4 yards per man per day of eight hours. But counting occasional delays the average was about 1 yard per man per day.

Some concrete had to be mixed by hand owing to either the mixer or derrick getting out of repair. In this event, the materials in proper proportions were wheeled to and dumped into the cars dry at the mixer, then transported to a temporary platform built close to the parapet, mixed, and put in place. The men were organized as follows for this kind of work:

1 foreman	$2.50
3 laborers, at $1, wheeling sand	3.00
8 laborers, at $1, wheeling gravel	8.00
2 laborers, at $1, breaking cement bands and handling cement	2.00
3 laborers, at $1.50, breaking cement barrels and handling cement	4.50
3 laborers, at $1.50, at turn-tables	4.50
5 laborers, at $1, pushing cars	5.00
Total, 25 men	29.50

1 foreman	2.50
8 laborers, at $1, pushing and unloading cars	8.00
12 laborers, at $1, shoveling and mixing materials	12.00
2 laborers, at $1, handling water	2.00
8 laborers, at $1, wheeling materials	8.00
5 laborers, at $1, shoveling materials	5.00
8 laborers, at $1, tamping	8.00
Total, 44 men	45.50

Ironwork.—The ceilings of magazines and passageways are made flat; 5, 6, 7, and 8-inch I-beams being placed 2 feet apart, center to center, span all the passages. The observing station is provided with a cover made of boiler iron. Four grooved wheels running on a track are attached, enabling the cover to be run backward, uncovering the station when desired, and at other times to be run forward so as to cover the station, keeping out rain. In the south magazines there are two ammunition lifts. A trolley system, continuous from one emplacement to the other, affords ample means of conveying ammunition. Steel plates 1 inch thick constitute the ceilings and cover over the shot rooms and passageways of the gun platforms. These and the anchor bolts, stairways, cranes, ventilator pipes, etc., constitute the ironwork already purchased.

All except the cranes and the back stairways leading down from the gun platforms are already in place. There are yet to be purchased 16 triplex blocks for the cranes and trolleys. The cost has been as follows:

Materials:	
Steps	$159.68
Ceiling beams and anchor bolts	746.32
Ventilator pipes, bolts, and miscellaneous iron	207.00
Trolleys, hoists, plates, etc	3,516.32
	4,629.32
Labor	1,300.10
Total	5,929.42

Doors and windows.—This includes the doors and windows fitted in brass frames for lamp chambers; wooden doors at entrances to magazines and passageways, their hinges, gudgeons, and fittings. They are not finished.

The cost up to June 30, 1897, has been—	
Materials	$1,055.88
Labor	219.70
Total	1,275.58

Ventilators and asphalt.—A thin coat of asphalt has been placed under the floors of both magazines and the entire area of the traverse, a layer above and covering the entire area of the south magazines. It was omitted above the traverse and the north magazines. The purpose of the asphalt was to prevent the penetration of water and keep the magazines dry. The south magazines were surrounded by a continuous partition of hollow tile extending from a little below the level of the floors to 2 feet above the ceilings, and a similar partition was placed in the parapet in front

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of the traverse. They are laid with a slight incline and all open to the air. They are designed to serve as an air passage and for ventilators, to intercept all water that might seep through the concrete from the earth parapet, and to serve as a drain. There is none surrounding the north magazines, and for want of this, or a coating of asphalt over the ceilings, or both, they leak badly during heavy rains. Ventilator pipes extend from every room and lantern chamber to the top of the concrete and are furnished with a return elbow. Cost of asphalting:

Materials:	
Asphalt, at $50 per ton	$100.48
Coal tar, 5 barrels, at $4.35	21.75
	122.23
Labor	63.00
Total, 145 square yards, at $1.27½	185.23

Earth parapet.—The earth parapet was built entirely with wheelbarrows. There was 12,000 yards in all. About 2,500 yards was built previously to completion of the concrete February 28, 1897, this work having been kept in reserve as an odd job to work at when, on account of breakdowns to plant or other causes, laborers would otherwise have been idle. The remaining 9,500 yards was built from March 1 to April 10, 1897, beginning with about 120 laborers working in night and day shifts till March 4, and reducing the number to 50 by April 10. The area within which barrow pits were made was small, and therefore quite deep—about 8 feet. The maximum height from bottom of barrow pits to top of parapet was 26 feet. The river began rising early in March and most of the work had to be done during very high water. The seepage was great, and the overflow water into the rear bays and bayous backed up into the moats, making it necessary to connect the front levee with the battery with a protection levee. The large hoisting engine was moved to the levee, fitted up with a large siphon, and the seepage water pumped into the river. This pump was kept running day and night, and in addition two wooden 3-man hand pumps, made on the ground, were kept running much of the time. These conditions made the earthwork very expensive—far above the estimate. Its total cost was $6,225.88, which was 51.91 cents per yard.

Miscellaneous.

1. The cost of clearing, grading, and miscellaneous work not directly connected with construction of battery was	$1,325.50
2. Cost of miscellaneous supplies and materials	1,115.32
3. Moving shot and weighting platforms	1,045.60
4. Moving three 15-inch gun carriages delivered in July, 1896, from the wharf to inside the water battery, a distance of about 800 feet	287.25
Grand total	3,773.67

CONCLUSION.

It does not appear certain that any form of construction can be relied upon to preserve its original levels. The soil is exceedingly compressible, as is evidenced by the fact that no swelling of sufficient consequence was observable, although a very considerable volume of timber was driven into it. The full frictional resistance of the pile was developed by the compression of the soil, and it is possible that the same results might have been attained with fewer piles. It is not reasonable to expect that the deeper strata of soil possesses sufficient supporting power to promise a complete exemption from settlement in the event of much longer piles being used. Unequal settlement is to be apprehended, and it is altogether likely that a continual subsidence may be expected. The subsidence being due mainly to weight, it appears that when a gun platform is built upon a sufficiently large foundation so as to involve a large mass of earth, and when the piles are so proportioned as to develop their full frictional resistance, the disturbance of the platforms by the shock of firing need not be apprehended unless the concussion is sufficient to disturb the entire foundation, etc. The maintenance of exact level of such a platform can not be guaranteed.

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If it is indispensably necessary to construct forts of any description at this locality, masonry or other constructions which do not admit of easy readjustments should be sparingly used, and when necessary should be founded upon pile grillage covering wide areas, and as nearly as possible should be symmetrical as to loaded area so that subsidence may be uniform.

Money statement.

July 1, 1896, balance unexpended	$48,289.91
July 3, 1896, amount allotted	55,000.00
November 25, 1896, amount allotted	35,000.00
April 8, 1897, amount allotted	3,000.00
	141,289.91
June 30, 1897, amount expended during fiscal year	138,459.61
July 1, 1897, balance unexpended	2,830.30
July 1, 1897, outstanding liabilities	2,208.47
July 1, 1897, balance available	621.83

3 R.

DEFENSES OF GALVESTON, TEXAS.

Officer in charge, Maj. Alexander M. Miller, Corps of Engineers; assistants, Lieut. William V. Judson, Corps of Engineers, to February 25, 1897, and Lieut. Charles S. Riché, Corps of Engineers, since June 20, 1897; Division Engineer, Col. John W. Barlow, Corps of Engineers, to May 11, 1897, and Col. Henry M. Robert, Corps of Engineers, after that date.

Mining casemate.—Work was commenced on the casemate June 26, 1896, but very little was accomplished up to the close of the last fiscal year. Its construction was continued during the present year, the body having been completed on July 28, 1896, the gallery on October 9, the mound covering on January 18, 1897, and the casemate on June 30.

The estimated cost was $19,562.40, and allotments of that amount were made for its construction. Its actual cost was $15,009.27, a saving of $4,553.13 on the estimate.

In mixing the concrete, the aim was to have the cement, sand, and stone in the proportion of 1:3:8, or 1 barrel cement, 4½ cubic feet, to 13½ cubic feet sand, to 36 cubic feet stone. The materials used were Alsen white label cement, San Jacinto sand, and sandstone. The stone was of two sizes, crushed and large pieces weighing from 50 to 100 pounds, the actual proportion used being 6.7 to 1. The cement cost $2.50 per barrel, the sand $1.55 per cubic yard, and the stone $2.95 per cubic yard.

The cost of the casemate may be summarized as follows:

Body, 884.7 cubic yards concrete, at $8.424	$7,452.62
Gallery, 200.4 cubic yards concrete, at $8.05	1,613.22
Floors and walks	213.23
Embankment, including sodding, 10,795 cubic yards, at 33 cents	3,562.35
Door and frame	65.00
Drain and ventilator pipes	18.50
Riprapping base of mound	768.06
Cement-testing outfit	179.65
Tools	105.25
Fence and gate	30.60
Superintendence and contingencies	1,000.79
Total cost	15,009.27

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An average settlement of 1.12 feet has occurred in the casemate.

Money statement.

July 1, 1896, balance unexpended	$9,064.64
July 16, 1896, amount allotted	9,562.40
	18,627.04
June 30, 1897, amount expended during fiscal year	13,123.10
July 1, 1897, balance unexpended	5,503.94
July 1, 1897, outstanding liabilities	950.81
July 1, 1897, balance available	4,553.13

Emplacements for two 10-inch guns.—A project for the construction, by hired labor, of emplacements for two 10-inch guns was approved November 13, 1896, and their construction was commenced November 23, under an allotment of $100,000. The total estimated cost of the battery, including pile revetment protection, was $133,387.37.

Before the construction of the battery could be commenced, it was necessary to raise the site to a level of 8 feet above mean low tide. While this was going on a side track and trestle with necessary switches was built, so as to facilitate the transportation of material for use in the construction. The necessary plant, consisting of a locomotive, two derricks, a concrete mixer, engines, and other appliances, needed in carrying on the work, were also purchased, and the necessary temporary buildings, tramways, and material bins built.

By the time the raising of the site had been completed on January 25, 1897, everything was about in readiness to commence the mixing of concrete. This, however, was delayed until March 10, owing to the non-arrival of the anchor bolts for the gun platforms.

The construction of platforms was commenced March 10, 1897, and from that time on the concrete construction was carried on as rapidly as circumstances would permit, so that by the end of the fiscal year the gun platforms and parapet walls, except a thickness of 4 feet in wall for gun No. 2, had been completed, except granolithic covering. Chambers behind gun No. 1 were completed, except floors and hanging doors; chambers behind gun No. 2 were partially completed. The iron protection over magazine, shell rooms, and passageways was placed, and the two former were completed.

To protect the battery from damage, due to storms and high tides, sheet piling, protected on the outside by riprap, was ordered placed, the sand filling behind the revetment to be protected on top by riprap. The material for this work was on hand at the end of the year, but it had not been commenced.

Arrangements were also made for having the sand protection placed for the battery.

The concrete for this battery is in the proportion of 1½ barrels cement, 13½ cubic feet sand, and 27 cubic feet crushed rock. Alpha Portland cement, at $2.65; Connelly & Shafer's Rosendale cement, at $1.33; San Jacinto sand, at $1.28 per cubic yard; crushed sandstone, at $2.87 per cubic yard, and large stone, at $2.35 per ton, were used in making concrete. Small crushed stone for granolithic work cost $3.05 per cubic yard.

A cubical mixer 4 by 4 by 4 feet was used in mixing the material. The average number of turns per minute was 16½, and per batch 9. The average charge measured loose was 47.25 cubic feet, and measured in place 35.10 cubic feet. The average number of charges per day was

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88. The average number of cubic yards of concrete mixed, placed, and rammed was 114.24.

The amount of concrete placed in parapet walls and traverses was 7,739 cubic yards and in platforms 640 cubic yards.

The following quantities of material were used in making this concrete:

Alpha Portland cement	barrels	580.75
Connelly & Shafer's Rosendale cement	do	8,725.00
San Jacinto sand	cubic yards	3,061.79
Crushed stone	do	6,074.93
Large rock	tons	808.02

The cost per cubic yard of concrete placed in parapet walls and traverses was, for—

Framing	$0.3183
Materials, including unloading	5.0705
Mixing, placing, and ramming	.5350
Total	5.9238

The cost per cubic yard of concrete in gun platforms was, for—

Framing	$0.3183
Materials, including unloading	6.7075
Mixing, placing, and ramming	.5350
Total	7.5608

The cost of granolithic finish was, per cubic yard, for—

Framing	$0.3183
Materials, including unloading	8.2410
Mixing, placing, and ramming	8.7000
Total	17.2593

The I-beam, plates, and girders placed in the battery weighed 428,945 pounds and cost 2.229 cents per pound.

The following amounts were expended for plant, etc., used in connection with this work:

Spur track and trestle from south jetty to battery	$7,868.35
Power house, with machinery	1,826.10
Concrete plant, including mixer, dump cars, etc	1,176.93
Cement shed	287.25
Material bins	833.09
Tramway	438.45
Field office	58.70
Water plant, including pump, water car, etc	615.05
Two derricks, complete with engines, bull wheels, and turning winches, masts 80 feet, booms 75 feet	4,813.28
Locomotive	2,179.95
Caboose	244.60
Steam pile driver	247.21
Hand pile driver	3.35
Total	20,592.31

The total amount expended on this battery to June 30, 1897, was $79,702.15. An itemized statement of the cost of the battery will be prepared after its completion.

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Money statement.

September 25, 1897, amount allotted to date	$100,000.00
June 30, 1897, amount expended during fiscal year	79,702.15
July 1, 1897, balance unexpended	20,297.85
July 1, 1897, outstanding liabilities	11,631.69
July 1, 1897, balance available	8,666.16

Emplacements for eight 12-inch mortars.—Under date of November 12, 1896, plans for this battery were furnished by the Department with instructions to advertise the work, which was done on November 12, bids to be opened November 30, 1896. Five proposals were received, the lowest being that of Henry L. Breneman, of Paris, Tex., with whom a contract was entered into on December 15, 1896, for constructing the battery. An abstract of the bids received is forwarded herewith.

Work under the contract was not commenced until February 20, 1897, and but slow progress was made up to the close of the year, owing principally to the inexperience of the contractor in such kind of work, and because a severe storm, which occurred on March 28, 1897, practically swept away such work as had been done up to that time. Owing to the exposed position of this battery, it became necessary to enter into an additional agreement with the contractor to build a sheet-piling revetment around the battery, protected on the outside with riprap, as well as on the top of the sand filling directly behind it.

At the close of the fiscal year the raising of battery site had been completed to the 6-foot level over its south half; over the remainder the height varied from 2 to 5 feet. The footings for all walls, except engine room and approaches, are completed south of gun platforms; the foundations for other walls are only partly completed. The mortar platforms were completed and are ready to receive the ironwork. The sheet-piling revetment was completed and protected on the outside with riprap.

The following quantities of material were placed in this battery during the year:

Sand fill	cubic yards	14,127.93
No. 2 concrete	do	1,273.24
No. 3 concrete	do	10.40
Cut stone	do	127.87
Riprap	tons	2,003.00
Anchor bolts, etc	pounds	26,220.00
Drift bolts	do	546.00
Grillage lumber	feet	12,324.00
Sheet piling	linear feet	1,456.00

The total estimated cost of this battery is $115,000, to cover which allotments have been made; the total amount expended to June 30, 1897, was $9,374.56.

Money statement.

April 27, 1897, amounts allotted to date		$117,700.00
June 30, 1897, amount expended during fiscal year		9,374.56
July 1, 1897, balance unexpended		108,325.44
July 1, 1897, outstanding liabilities	$18,667.04	
July 1, 1897, amount covered by uncompleted contracts	88,444.02	
		107,111.06
July 1, 1897, balance available		1,214.38

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Sites.—On January 12, 1897, an allotment of $71,000 was made for the purchase of fortification sites.

The Attorney-General having passed favorably on the title to one of the sites, it was purchased and paid for on March 23, 1897.

The title to the other site is now being investigated by the United States district attorney.

Money statement.

January 12, 1897, amount allotted to date	$71,010.65
June 30, 1897, amount expended during fiscal year	35,010.65
July 1, 1897, balance unexpended	36,000.00

Cement testing.—This was continued during the year. In addition to the testing of samples taken from the cement furnished for the different works, a number of other brands were tested, furnished by local dealers, for the purpose of ascertaining the quality of the cement usually kept on hand at this place.

The results of this testing are given in the following tables:

Cement tests made during the fiscal year ending June 30, 1897

MIXED NEAT.

Brand.	No. sample.	No. briquet.	Fineness.	Time of setting.		Strength in pounds per square inch.			Amount water.	Remarks.
				¼ pound 1/12 needle.	1 pound 2/12 needle.	Age 24 hours.	Age 7 days.	Age 28 days.		
			Per ct.	*h. m.*	*h. m.*				*Per ct.*	
"Alpha," Portland	29	171	99	1 50	3 45	205	810	882	16	Fresh water.
Do	5	35	99	2 55	4 54	77	613	770	20	Do.
Do	2	12	99	1 32	3 15	382	663	805	16	Salt water.
"Connelly & Shafer," Rosendale.	7	51	91	0 30	0 49	53	66	225	33	Fresh water.
Do	39	230	91	0 32	1 06	119	130	272	25	Do.
Do	71	424	91	0 37	1 13	69	100	293	30	Do.
Do	4	24	91	0 37	1 26	118	148	245	25	Salt water.
Do	1	6	91	0 40	1 40	113	92	212	30	Do.
"Beach," Rosendale	3	18	99	2 31	4 08	113	154	271	30	
"Hoffman," Rosendale	1	6	91	0 30	0 55	142	185	248	25	
Do	1	6	91	1 45	2 15	69	85	154	33	
"Brooklyn Bridge," Rosendale.	2	12	91	0 45	1 30	165	128	253	25	
Do	1	6	91	2 00	3 45	117	190	241	25	Do.
"Parrott Belgin," Portland.	*1	6	98	1 50	4 00	133	200	300	20	Fresh water.
Do	*1	4	98	1 40	3 50	102	189	186	25	
"Eagle Belgin," Portland.	*1	6	99	1 30	3 40	184	284	417	20	
Do	*1	4	99	1 50	4 00	217	476	455	25	
"Hemmoor German," Portland.	*1	6	99	2 00	5 00	341	579	675	20	
"Alsen W. L.," Portland	*2	12	99	2 00	4 00	356	639	650	20	Do.
Do	*1	6	99	2 00	4 00	312	605	652	20	Salt water.

*On the above brands from William Parr & Co., Galveston, Tex., samples furnished by them for test purposes only.

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MIXED WITH ADULTERANTS.

Brand	No. sample.	No. briquet.	Proportions by weight.			Strength in pounds per square inch.			Nature of adulterant.
			Cement.	Adult.	Water.	Age 24 hours.	Age 7 days.	Age 28 days.	
			Oz.	*Oz.*	*Oz.*				
"Alpha," Portland	4	18	10	20	3	43	334	450	Sharp sand.
Do	4	18	10	30	4	53	382	355	Do.
Do	4	18	10	20	3	73	365	435	Sharp sand; salt water.
Do	4	18	10	30	4	.....	273	325	Do.
Do	1	4	10	20	3	.....	209	311	Beach sand; fresh water.
Do	1	4	10	20	3	.....	209	250	Beach sand; salt water.
			Proportions by volume.						
"Connelly & Shafer," Rosendale.	1	6	10	20	3	1	16	88	Sharp sand; fresh water.
Do	1	6	10	20	3	24	32	90	Sharp sand; salt water.
Do	1	4	10	20	3	.....	1	33	Beach sand; fresh water.
Do	1	4	10	20	3	.....	1	66	Beach sand; salt water.
Do	2	8	10	30	4	.....	17	59	Sharp sand; fresh water.
Do	2	8	10	30	4	.....	19	57	Sharp sand; salt water.
"Beach," Rosendale	1	6	8	24	4	27	35	78	Sharp sand; fresh water.
Do	2	12	8	16	3	55	66	142	Do.
"Brooklyn Bridge," Rosendale.	1	6	8	24	4	12	17	42	Do.
Do	1	6	8	24	4	20	24	65	Sharp sand; salt water.
			Proportions by weight.						
"Parrot," Portland	1	6	10	30	4	60	89	165	Sharp sand; fresh water.
"Eagle," Portland	1	6	10	30	4	103	171	238	Do.
"Hammoor," Portland	1	6	10	30	4	108	208	245	Do.
"Alsen W. L.," Portland	1	6	10	30	4	129	269	361	Do.
Do	1	6	10	50	6	41	136	203	Do.
Do	1	6	10	40	5	170	272	312	Do.

Abstract of allotments made for fortifications at Galveston, Tex.

FOR MINING CASEMATE.

Act of—		
August 18, 1890	$3,852.11	
February 24, 1891	1,469.08	
March 2, 1895	14,241.21	
		$19,562.40

FOR GUN BATTERY.

Act of June 6, 1896	100,000.00

FOR MORTAR BATTERY.

Act of—		
June 6, 1896	2,700.00	
March 3, 1897	115,000.00	
		117,700.00

FOR SITES FOR FORTIFICATIONS AND SEACOAST DEFENSES.

Act of June 6, 1896	71,010.65

PRESERVATION AND REPAIR OF FORTIFICATIONS.

Act of March 3, 1897	200.00
Grand total	308,473.05

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Abstracts of proposals for constructing a mortar battery at Galveston, Tex., received in response to advertisement dated November 12, 1896, and opened November 30, 1896, by Lieut. W. V. Judson, Corps of Engineers, United States Army, Galveston, Tex.

Items.	Henry L. Breneman, Paris, Tex.	Isaac Hoffron, Galveston, Tex.	John A. Davis, Galveston, Tex.	Thompson & Gray, St. Louis, Mo.	Lawrence V. Elder, Galveston, Tex.
Earth fill, 100,000 cubic yards	$0.00	$0.53	$1.50	$1.45	.....
Or—					
Sand fill, 100,000 cubic yards	.14	.22½	.47½	.21½	$0.50
Loam, 4,000 cubic yards	.75	.75	1.50	1.50	2.50
Sod, 8,000 square yards	.20	.15	.50	.20	3.00
No. 1 concrete, 10,000 cubic yards	5.11	7.35	8.50	6.57	9.00
No. 2 concrete, 1,000 cubic yards	6.37	9.15	10.00	8.24	12.00
No. 3 concrete, 600 cubic yards	8.76	10.15	17.00	12.69	19.50
Stone, 100 cubic yards	2.80	2.75	2.75	2.90	4.75
Cut stone, 115 cubic yards	55.00	64.00	30.00	50.00	75.00
I-beams, 63,000 pounds	.04	.03	.05	.04½	.23
Trolleys, etc., 17,500 pounds	.06	.08½	.05	.05	.29
Lumber for doors, 1,000 feet	.05½	.03	.03	.03	.03
Cypress, 430 feet	.06	.04	.03	.03	.07
Brass fittings, 400 pounds	.40	.50	.35	.12	.48
Iron fittings, 1,000 pounds	.15	.30	.20	.10	.24
Piling, 8,000 linear feet	.27	.23½	.25	.24	.39
Lumber, 10,000 feet	.02½	.02	.02	.02	.03
Spikes, 1,000 pounds	.09	.04½	.05	.06	.09½
Anchor bolts, 33,500 pounds	.06	.05	.10	.06	.31
Ladders, iron, 900 pounds	.10	.05	.05	.05	.27
Total	96,491.80	131,092.20	176,477.90	124,579.90	241,000.10

Contract awarded to Henry L. Breneman, of Paris, Tex., the lowest bidder.

List of contracts in force.

Contract dated December 15, 1896, with Henry L. Breneman, for constructing a mortar battery, approved January 5, 1897. Work to commence January 10, 1897, and to be completed July 30, 1897.

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3 S.

DEFENSES OF LAKE PORTS IN NEW YORK.

Officer in charge, Maj. W. S. Stanton, Corps of Engineers; Division Engineer, Col. (now Brig. Gen.) John M. Wilson, Corps of Engineers, until February 11, 1897, and Col. G. L. Gillespie, Corps of Engineers, after that date.

Site at Fort Niagara.—During the fiscal year ending June 30, 1897 (in October and November, 1896), the lake wall was thoroughly repointed; a few of its stones were relaid; its foundation for 80 linear feet at its westerly end, which was threatened by the lake, was protected by riprap and the wall is now in good condition.

The necessary survey has been made and contract prepared for sloping, grading, and protecting about 1,000 linear feet of the bank of the Niagara River, which is receding and approaching the road and the officers' quarters at the southerly part of the river front of the reservation. It is expected that this work will be completed in September, 1897, and the cost defrayed chiefly from the allotment of $13,000 from "Seawalls and Embankments," 1897.

The amount expended during the year was:

For repointing and repairing the parade wall and protecting its foundation	$1,101.25
For survey of the river bank	219.94
Total	1,321.19

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Fort Montgomery.—To arrest the separation of the scarp wall from the casemates, which is reported to have amounted in some places to as much as 2 inches, the scarp and the masonry of the casemates were several years ago tied together with iron rods.

Percolation of water from the terreplein down the joint between the facing and backing of the parade wall into the masonry of the casemate arches and its freezing in the long winters are damaging the casemate masonry. To prevent this damage the parade wall for a length of 103 feet was covered in November, 1896, with patent granite roofing laid in hot mastic as an experiment. As it has thus far proved satisfactory, the other 700 linear feet of the wall will be likewise covered with the patent roofing and mastic in August, 1897, pursuant to indorsement of May 27, 1897, at an estimated cost of $750.

The scarp wall and stone parapet are very much in need of repointing, for which an estimate amounting to $4,213.30 was submitted in letter of January 13, 1897. In the lower part of the scarp wall, on the two fronts that are most exposed to Lake Champlain, the joints are empty of mortar far into the wall. The amount expended during the year was $987.51.

It was applied—

To services of fort keeper	$495.00
To traveling expenses, services, labor, and materials in covering 103 linear feet of parade wall, in excavating earth to ascertain cause of leaking, inspection, and pay of assistant	492.51
Total	987.51

3 T.

DEFENSES OF SAN DIEGO, ISLANDS IN SAN FRANCISCO BAY, AND NORTH SIDE OF SAN FRANCISCO BAY, CALIFORNIA.

Officer in charge, Maj. Chas. E. L. B. Davis, Corps of Engineers; assistants, Lieut. Charles L. Potter, Corps of Engineers, to September 5, 1896, and Lieut. Herbert Deakyne, Corps of Engineers, since September 14, 1896; Division Engineer, Col. Charles R. Suter, Corps of Engineers.

By direction of the President the name of the fortification at Lime Point, on the north side of the entrance to the Golden Gate, was changed to Fort Baker. (See G. O. No. 25, A. G. O., May 4, 1897.)

Twelve-inch gun battery at San Francisco.—Allotments have been made for the construction of three emplacements, Nos. 3, 4, and 5, and the gun platforms therefor.

WORK DONE.

At the close of the last fiscal year the three emplacements were finished, with the exception of the elevator shafts, which could not be completed until the ammunition hoists were ready. One platform, No. 5, was completed and the other two left in an unfinished condition awaiting the arrival of the base rings.

During the past fiscal year the ammunition hoists and trolleys have been completed, the shafts and interior arrangements finished, two guns and their carriages mounted, and the base ring for the gun platform of emplacement No. 4 put in place and the platform completed. The mounting of the carriages and guns was done by detachments from the artillery under the capable direction of First Lieut. J. D. Miley, Fifth United States Artillery, post ordnance officer at the Presidio.

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The last carriage was delivered at its site in April last, and the gun is now being transported up the hill and will soon be in readiness to mount. As soon as the carriage and gun are mounted, the terreplein will be concreted, the parade ground graded, the slopes planted with grass seed, and the battery completed in all respects.

Money statements.

GUN EMPLACEMENTS.

July 1, 1896, balance unexpended	$8,482.15
Value of cement	671.31
Total	9,153.46
June 30, 1897, expended during fiscal year	5,532.90
June 30, 1897, balance unexpended	3,620.56

GUN PLATFORMS.

July 1, 1896, balance unexpended	$1,329.31
June 30, 1897, expended during fiscal year	773.44
June 30, 1897, balance unexpended	555.87

Mining casemate at San Francisco.—A project was submitted May 11, 1897, for the construction of a torpedo casemate, and by Department indorsement of May 21, 1897, the sum of $8,000 was allotted for this work. On the completion in the near future of the work now going on at the torpedo station at Yerba Buena Island the construction party will be transferred and the work commenced.

Money statement.

May 21, 1897, amount allotted	$8,000.00
June 30, 1897, balance unexpended and available	8,000.00

Ten-inch battery at San Diego, Cal.—Under Department instructions detailed plans, estimates, and specifications were submitted October 29, 1896, for emplacements for two 10-inch guns on disappearing carriages, in accordance with the approved project which contemplated a battery of four such guns at this locality. A survey of the site was first made, and a slight change made in the location, which brought the site upon that of the old barbette battery, reducing the amount of fill required, giving a greater field of fire, and less exposure to reverse fire. The total estimated cost of the two emplacements and the torpedo casemate, with 20 per cent contingencies and 10 per cent for contractor's profit, was $128,610.25.

On November 30, 1896, bids were opened for this work, three being received, ranging from $109,417.39 to $141,272.04. There were no funds available for the emplacements at the date of opening the bids, the act of June 6, 1896, authorizing the Secretary of War to enter into contracts for construction of fortifications, to be paid for as appropriations may from time to time be made by law. The contract was awarded to the lowest bidders, the California Construction Company, of San Francisco, Cal., the date of the contract being December 19, 1896, time of commencement of work on or before February 1, 1897, and time of completion on or before December 31, 1897.

The contractors commenced early in January and during that month built a wharf and roadway to the site of the work, and made connection by a 2-inch pipe with water system of San Diego, and commenced excavating for the site. The next month concrete work was commenced and in May work was commenced on the torpedo casemate.

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At the close of the fiscal year the condition of the work was as follows:

At Emplacement No. 2 all excavation on site of battery is finished. Excavation of terreplein is partly finished. The material is clay, mixed with sand, mostly made ground, and becomes very soft when wet. The excavated earth has been placed in embankment in front of emplacement and in traverse. On site of gun platform the ground was wet and very soft. It was excavated down to a firm stratum, then moist sand was placed in 6-inch layers and tamped; upon this the concrete was laid. The bearing power of the sand was tested before concrete was laid. A load of 7,600 pounds was placed upon an area 2 feet square, where the foundation consisted of 5 feet of sand, underlaid by a firm stratum of clay, sand, and shells. Upon the application of this load of 1,900 pounds per square foot, a settlement of one-half inch took place immediately; ten hours later an additional settlement of three thirty-seconds of an inch had taken place. The load was then removed and concrete laid.

All concrete of this emplacement is finished, except about 12 yards to be laid in gun platform after base ring arrives. Steel beams were placed in ceilings of all rooms having a span of 8 feet or more. All ceilings are flat. A speaking tube connects the guardroom of this emplacement with the guardroom of Emplacement No. 1. A narrow passage leads from upper corridor of Emplacement No. 2 to loading platform of Emplacement No. 1. To furnish points of attachment for tackle used in handling gun and carriage, five ringbolts were set at convenient points in front of gun and in boundary of loading platform. An iron stairway has been erected, leading from the terreplein to the loading platform. Two coats of paraffin paint have been applied to all walls which inclose rooms and which are to be covered with earth.

The drainage system consists of 3-inch cast-iron pipe under concrete and terreplein, and 3-inch drain tile around edges of concrete, all falling to a main drain of 8-inch cast-iron pipe. It is completed except the 3-inch pipe under terreplein and the main 8-inch pipe.

The anchor bolts for base ring have been set; the upper 18 inches of each bolt is free of concrete to allow of slight horizontal adjustment, if necessary. The trolleys and ammunition lifts are in process of erection. The work remaining to be done on this emplacement is completion of excavation of terreplein; such earth fill in parapet and traverse as may be necessary after excavation is completed, laying 12 yards of concrete, applying hard finish to rooms and passages, completing trolleys and lifts in working order, placing cranes, hanging doors, painting lumber strips for electric fittings, completing drainage system, and placing mouthpieces and whistles in speaking tubes.

The engine and dynamo room, located in the traverse between Emplacements Nos. 1 and 2, is finished except laying floors, applying hard finish, painting lumber strips for electric fittings, placing ventilating pipes, and hanging doors.

Emplacement No. 1 is under construction. It does not differ essentially from Emplacement No. 2. Excavation for concrete is finished except for a part of traverse wall. Excavated earth was placed in embankment in front of concrete. No excavation of terreplein has been made. The concrete of this emplacement is two-thirds done; all lower rooms are covered; loading platform is finished. All steel beams have been placed except those over upper corridor; they were used in all rooms and passages having a span of 6 feet or more. Part of speaking tube connecting relocating room and observing station has been laid. Bolts for trolley beams are all set. Nearly all of drainage system is in place. Nothing has been done on gun platform.

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Concrete No. 1 is made of 1 part cement, 3 parts sand, 8 parts broken stone, all by volume, measured loose. The following brands of cement have been used: Hilton, Germania Porta, White Brothers, and Josson. The sand is obtained on the beach near the work. It is clean, but fine-grained and not sharp; it is the best that has been found near by in large quantities. The stone used for concrete is made from cobbles gathered on the beach and broken in a Gates crusher. It is clean, hard, and sharp.

The concrete is mixed in a Ransome mixer. Each batch consists of 1 cubic foot of cement and corresponding amounts of sand and stone. After having been given ten turns in the mixer the concrete is emptied into a bucket, which is swung to the part of work under construction by a derrick. The concrete is then spread in 6-inch layers and tamped with iron tampers.

Large stone is embedded irregularly in No. 1 concrete. It comes from the quarry near the Sweetwater Dam and is of good quality. It is used in masses varying from hand stone up to 5 tons. Stones are placed not closer to each other than 6 inches and concrete is tamped around and between them.

No. 2 concrete is made of 1 part cement to 3½ parts of mixed sand and gravel. It is mixed by hand and is used in a 6-inch layer wherever a smooth surface is required. No. 1 and No. 2 are laid at the same time and are tamped together to make a good bond.

One derrick handles No. 1 concrete, another handles No. 2 concrete and large stone.

Floors of platforms and rooms subject to wear are made 6 inches thick. The lower 5¼ inches consists of 1 part cement to 6½ parts sand and finely broken stone, made poor in sand so as to leave a rough surface to bond with the top layer, which is three-fourths of an inch thick, of 1 part cement to 2 parts sand, floated smooth. The top of emplacement not subject to wear is made 6 inches thick, the lower 5¼ inches, same as above, and the top three-fourths of an inch, of 1 part cement to 1½ parts sand. All these surfaces have a slight inclination to prevent water standing on them.

Air spaces 3 to 4 inches thick were placed around rooms and passages 1 to 2 feet from walls. They extend from below the floor to the level of the ceiling, and are drained by iron pipes communicating with general drainage system.

The site of mining casemate has been excavated down nearly to the grade where concrete is to begin. No other work has been done on casemate.

Money statements.

TWO 10-INCH GUN BATTERY ON DISAPPEARING CARRIAGES.

Amounts allotted by Department letters of December 16, 1896, and March 27, 1897	$115,000.00
June 30, 1897, expended during fiscal year	50,201.77
June 30, 1897, balance unexpended	64,798.23

NOTE.—This includes the sum of $6,000 allotted for expenses outside of payments to contractor, of which $2,929.85 has been expended.

TORPEDO CASEMATE.

November 7, 1896, amount allotted	$8,030.00
June 30, 1897, expended during fiscal year	189.00
June 30, 1897, balance unexpended	7,841.00

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On June 17, 1897, a project was submitted, in obedience to Department instructions, for constructing another or the third emplacement of this battery at an estimated cost of $49,630.22. This estimate was based on the last contract figures obtained, but it was thought that cheaper figures ought to be received for this new emplacement, particularly as there would be no uncertainty about the money being available and as the contractors were already established there with wharf, water supply, plant, and workmen. It was therefore recommended that bids be solicited and that if the lowest exceeded $45,000 all of the bids be rejected and the work done by hired labor.

Sites.—In pursuance of authority of Secretary of War of October 15, 1896, 40.63 acres of land was purchased at a cost of $2,031.50 for the site of a proposed mortar battery.

Money statement.

October 17, 1896, amount allotted	$2,500.00
June 30, 1897, expended during fiscal year	2,066.70
June 30, 1897, balance unexpended	433.30

Abstracts of bids for constructing a two 10-inch gun battery on disappearing carriages and torpedo casemate at San Diego Harbor, California, called for by advertisement of November 9, 1896, and opened November 30, 1896, by Maj. Chas. E. L. B. Davis, Corps of Engineers, United States Army.

No.	Bidder.	Address.	Amount of bid.
1	William Osburn	San Diego, Cal	$141,272.04
2	William H. Healy	San Francisco, Cal	134,379.72
3	California Construction Co	do	109,417.39

NOTE.—The different items of the work were bid for separately: Excavation, fill, and concrete, by the cubic yard; steel beams, bolts, etc., by the pound; gun-metal fittings, etc., for same, by the pound; pipe, by the linear foot; lumber, by the thousand feet; ammunition lifts and cranes, at so much a piece; all materials to be bid for in place.

List of all contracts in force June 30, 1897.

Work.	Contractor.	Date of contract.	Approved by Chief of Engineers.	Approved by Secretary of War.	Time of beginning work.	Time of completion.
1. Construction of a two 10-inch gun battery on disappearing carriages and a torpedo casemate.	California construction Co., San Francisco, Cal.	Dec. 19, 1896	Jan. 22, 1897	.....	Feb. 1, 1897	Dec. 31, 1897
2. Contract supplementary to above for additionnl articles and changes.	.....do	Mar. 2, 1897	Mar. 23, 1897	Apr. 2, 1897	On approval of contract.	Do.

3 U.

DEFENSES OF SAN FRANCISCO, CALIFORNIA, ON SOUTH SIDE OF BAY.

Officer in charge, Col. Charles R. Suter, Corps of Engineers; assistants, Capt. Joseph E. Kuhn, Corps of Engineers, until July 26, 1896, and Lieut. Charles L. Potter, Corps of Engineers, since September 5, 1896.

Construction of gun and mortar batteries.—At the end of the last fiscal year the only operations in progress were the installation of ammunition conveyors, etc., in Mortar Battery No. 1.

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Under the appropriation for gun and mortar batteries made by act approved June 6, 1896, an allotment of $168,000 was made for continuing work on these defenses of San Francisco. The armament to be provided for was as follows, viz: One 12-inch B. L. rifle, to be mounted on Crozier-Buffington disappearing carriage; two 12-inch B. L. rifles, to be mounted on nondisappearing carriages; two 5-inch rapid-fire guns. The plans for Emplacement No. 8 were approved September 12, 1896, and construction began in October, 1896. Plans for Emplacements Nos. 18 and 19 were approved November 20, 1896, and construction began immediately. Nothing could be done about the rapid-fire guns, as no information was available relative to the mounting.

Every effort was made to hasten the construction of these works so as to have them ready for their armament by December 1, but this proved impracticable owing to frequent heavy rains which ruined the roads and rendered the hauling of rock well-nigh impossible. However, all three platforms were ready for the guns by the end of December and the concrete work at Emplacement No. 8 was well advanced. It was completed in January, 1897, and the concrete plant transferred to Nos. 18 and 19. The weather conditions were greatly improved in the case of these latter emplacements and they were built with great rapidity. At the close of the year all three emplacements were completed with the exception of some interior ironwork, and for Nos. 18 and 19 carriages had been received, and one gun, which has since been mounted.

More or less work has been done during the year about all the earlier built emplacements. At Mortar Battery No. 1 the installation of ammunition conveyors and firing circuits was substantially completed and the new exterior firing room built. At Emplacements Nos. 14, 15, and 16, for 12-inch guns, the macadam terrepleins were removed and concrete pavement substituted. A guard and relocator room with observation station, speaking tubes, etc., is in process of construction and nearly completed at Emplacement No. 14. At Emplacements Nos. 11, 12, and 13 tunnels have been cut through the masonry to give access to the counterweight wells, and the terrepleins of these works will also receive a concrete pavement. Some ironwork still remains to be done, having been postponed pending the mounting of the guns.

During the year there were received two 12-inch guns, three 12-inch nondisappearing carriages, and one 10-inch disappearing carriage. Two 12-inch guns and carriages have been mounted at Emplacements Nos. 14 and 18, and two 10-inch guns and carriages at Emplacements Nos. 11 and 12. The third 10-inch carriage, while being mounted at Emplacement No. 13, was broken by the falling of the counterweight. All this work was done under the direction of Lieutenants Miley and Randolph, acting ordnance officers at the presidio. The labor was furnished by details from the artillery troops in garrison and from the hired laborers of the Engineer Department.

Owing to the unsatisfactory character of the water supply to the batteries, a new plan was projected for four reservoirs on Rob Hill, supplied by the quartermaster's pumping plant near Mountain Lake. This plan having been approved, the first reservoir of the series was built and all pipe connections made. As long as the water supply holds good this arrangement promises to be very satisfactory.

On May 25, 1897, I was informed that plans submitted for Emplacements Nos. 9 and 10, for 10-inch rifles on United States carriage, model 1896, had been approved and an allotment of $57,000 made for their construction. On June 14, 1897, I was further informed that plans for a mortar battery of sixteen 12-inch rifled mortars had also been approved and an allotment of $108,000 made for its construction.

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Work has been begun at both places, and will be pushed as actively as possible so as to get the heavy work done before the winter rains set in. The rapid-fire emplacements will also probably be constructed during the season.

Preservation and repair of fortifications.—Operations under this appropriation have been confined to care of property and minor repairs to the works. A fort keeper was employed throughout the year. In addition a landslide in Mortar Battery No. 1, caused by heavy rains, has necessitated repairs to the slopes, and four platforms for 8-inch converted rifles have been nearly completed.

At the beginning of the year Capt. Joseph E. Kuhn, Corps of Engineers, was in immediate charge of these works, under Colonel Suter's orders. He was relieved on July 25. On September 5, First Lieut. Charles L. Potter reported for duty and was given the same charge, which he has filled very satisfactorily throughout the year. A copy of his report is appended for fuller information as to details.

Allotments.

GUN AND MORTAR BATTERIES.

Emplacements, etc.:		
September 11, 1890 (act August 18, 1890)		$100,000.00
March 10, 1891 (act August 18, 1890)		101,000.00
July 2, 1891, cement (act February 24, 1891)		15,000.00
September 29, 1891, cement (act February 24, 1891)		10,000.00
November 9, 1891, cement (act February 24, 1891)		5,000.00
December 4, 1891, cement (act February 24, 1891)		5,000.00
December 23, 1891, cement (act February 24, 1891)		5,000.00
January 20, 1892, cement (act February 24, 1891)		10,000.00
February 17, 1892—		
Act August 18, 1890	$59,000.00	
Act February 24, 1891	87,332.00	
		146,332.00
		397,332.00
February 4, 1893, authority to apply to construction of mortar battery No. 1—		
Act August 18, 1890	$45,000.00	
Act February 24, 1891	70,118.50	
June 8, 1896, transferred to mortar battery No. 1 (act August 18, 1890)	1,500.00	
October 5, 1893, withdrawn (act February 24, 1891)	10,500.00	
March 3, 1894, withdrawn (act February 24, 1891)	3,600.00	
		130,718.50
Balance		266,613.50
Gun platforms, etc. (10-inch guns, emplacements 11, 12, 13):		
May 28, 1895 (act August 1, 1894)		5,000.00
June 15, 1895 (act March 2, 1895)		8,838.00
November 15, 1895, transferred from mortar platforms (act August 1, 1894)		2,150.22
Total		15,988.22
Gun platforms, etc. (12-inch guns, emplacements 14, 15):		
December 14, 1895—		
Act August 1, 1894	$4,627.55	
Act March 2, 1895	972.45	
		5,600.00
September 15, 1896, transferred to platform of emplacement No. 8 (act March 2, 1895)	691.90	
November 20, 1896 transferred to mortar battery No. 1 (act March 2, 1895)	125.00	
		816.90
Balance		4,783.10

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Gun platforms, etc. (12-inch gun, emplacement 16):		
September 29, 1894 (act August 1, 1894)		$4,000.00
November 15, 1895, withdrawn (act August 1, 1894)		1,101.57
Balance		2,898.43
Mortar battery No. 1:		
February 4, 1893, authority to apply to construction of mortar battery No. 1, from funds allotted for emplacements, etc.—		
Act August 18, 1890	$45,000.00	
Act February 24, 1891	70,118.50	
		115,118.50
June 8, 1896, transferred from emplacements, etc. (act August 18, 1890.		1,500.00
November 20, 1896, transferred from 12-inch gun platforms, emplacements 14, 15 (act March 2, 1895)		125.00
November 20, 1896, transferred from emplacements, etc. (act June 6, 1896)		275.00
		117,018.50
December 31, 1895, withdrawn (act February 24, 1891)		5,118.50
Balance		111,900.00
Mortar platforms, etc.:		
March 14, 1893 (act February 18, 1893)		10,000.00
September 5, 1894 (act August 1, 1894)		25,641.00
		35,641.00
November 15, 1895, withdrawn (act August 1, 1894)	$3,525.98	
November 15, 1895, transferred to 10-inch gun platforms, emplacements 11, 12, 13 (act August 1, 1894)	2,150.22	
		5,676.20
Balance		29,964.80
Emplacements, etc.:		
July 3, 1896, (act June 6, 1896)		168,000.00
September 15, 1896, transferred from 12-inch gun platforms, emplacements 14, 15 (act March 2, 1895)		691.90
		168,691.90
November 20, 1896, transferred to mortar battery No. 1 (act June 6, 1896)	$275.00	
February 11, 1897, transferred to water supply (act June 6, 1896)	9,300.00	
December 16, 1896, withdrawn (act June 6, 1896)	12,000.00	
		21,575.00
Balance		147,116.90
Water supply for defensive works:		
February 11, 1897, transferred from emplacements, etc. (act June 6, 1896)		9,300.00
Emplacements 9 and 10:		
May 25, 1897 (act March 3, 1897)		57,000.00
Mortar battery No. 2:		
June 14, 1897 (act March 3, 1897)		108,000.00

Money statements.

GUN AND MORTAR BATTERIES.

Emplacements, etc.

July 1, 1896, balance unexpended	$4,858.19
June 30, 1897, amount expended during fiscal year	4,800.72
July 1, 1897, balance unexpended	57.47

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Gun platforms, etc. (10-inch guns, emplacements 11, 12, 13).

July 1, 1896, balance unexpended		$669.97
June 30, 1897, amount expended during fiscal year		58.25
July 1, 1897, balance unexpended		611.72

Gun platforms, etc. (12-inch guns, emplacements 14, 15).

July 1, 1896, balance unexpended		$816.90
June 30, 1897, amount transferred during fiscal year:		
To platform emplacement 8	$691.90	
To mortar battery No. 1	125.00	
		816.90

Mortar Battery No. 1.

July 1, 1896, balance unexpended		$3,970.41
November 20, 1896, by transfer:		
From emplacements, etc	$275.00	
From 12-inch gun platforms, emplacements 14, 15	125.00	
		400.00
		4,370.41
June 30, 1897, amount expended during fiscal year		4,271.05
July 1, 1897, balance unexpended		99.36

Emplacements, etc.

July 3, 1896, amount allotted		$168,000.00
September 15, 1896, transferred from 12-inch gun platforms, emplacements 14, 15		691.90
		168,691.90
November 20, 1896, transferred to mortar battery No. 1	$275.00	
February 11, 1897, transferred to water supply, Fort Point	9,300.00	
December 16, 1896, withdrawn	12,000.00	
		21,575.00
		147,116.90
June 30, 1897, amount expended during fiscal year		89,935.66
July 1, 1897, balance unexpended		57,181.24
July 1, 1897, outstanding liabilities	$3,302.27	
July 1, 1897, amount covered by uncompleted contracts	32.81	
		3,335.08
July 1, 1897, balance available		53,846.16

Emplacements 9 and 10.

May 25, 1897, amount allotted		$57,000.00
June 30, 1897, amount expended during fiscal year		748.35
July 1, 1897, balance unexpended		56,251.65
July 1, 1897, outstanding liabilities	$15,078.34	
July 1, 1897, amount covered by uncompleted contracts	24,111.12	
		39,189.46
July 1, 1897, balance available		17,062.19

Mortar Battery No. 2.

June 14, 1897, amount allotted		$108,000.00
July 1, 1897, outstanding liabilities	$266.25	
July 1, 1897, amount covered by uncompleted contracts	11,861.53	
		12,127.78
July 1, 1897, balance available		95,872.22

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Water supply for defensive works.

February 11, 1897, by transfer from emplacements, etc	$9,300.00
June 30, 1897, amount expended during fiscal year	9,025.07
July 1, 1897, balance unexpended	274.93
July 1, 1897, outstanding liabilities	274.93

EXTRACT FROM REPORT OF FIRST LIEUT. CHARLES L. POTTER, CORPS OF ENGINEERS.

MORTAR BATTERY NO. 1.

Ammunition carrier.—The installation of ammunition carrier in the battery, which was begun during the previous year, has been completed, and the total amount of money expended thereon during the year, $1,762.70.

Firing room.—A new firing room has been built, at a cost of $1,236.25.

Firing circuits, etc.—A new firing circuit has been installed. The four guns of each pit are connected to a switch board, which stands at the entrance to the gallery from the pit. It is intended to fire each pit separately from this point, so that the firing connections are made with the guns right in front of the operator. By manipulating the switches the guns in any pit can be fired in succession as rapidly as the exploder can be worked, or any number of guns can be fired at once in multiple arc, if desired. In addition to this, the electric lights have been extended to the firing room. The total cost of this work has been, up to June 30, $220.70. There is still a little work to be done.

Office expenses and contingencies.—The amount expended under this head is $799.90.

Recapitulation.

Ammunition carrier	$1,762.70
Firing room	1,236.25
Firing circuits	222.70
Office expenses, etc	799.90
Total	4,021.55

WATER SUPPLY.

The new water supply for the batteries has been put in and the reservoir connected with the pumping station belonging to the Quartermaster's Department. The work is nearly completed, there being some small items and an electrical indicator yet to be put in, and for which there is no money available at present. Cost to June 30, $9,225.32.

EMPLACEMENTS 11 TO 16, INCLUSIVE.

The principal expenditures from this allotment have been for current expenses, together with small matters of repair or change from time to time, and the mounting of guns.

The expenditures are as follows:

Mounting guns	$462.45
Repairs to carts and wagons	44.57
Shoeing Government horses	50.11
Running water supply	120.78
Repairs to buildings	167.25
Feeding Government horses	215.17
Office expenses	560.00
Incidentals	84.09
Locks for doors	43.81
Total	1,748.23

10-INCH GUN PLATFORMS, EMPLACEMENTS 11, 12, AND 13.

The only work under this allotment has been the finishing of the top of the platform at emplacement 11, at a cost of $58.25.

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EMPLACEMENTS 8, 18, 19 AND IMPROVEMENTS AT EMPLACEMENTS 11 TO 16.

Emplacement No. 8.—Work was begun on this emplacement in October, and, with the exception of a few small matters, is finished. The work was carried on with a view to getting it done at the earliest date possible. The season of the year in which the work was done was about the worst, but it so happened that material, especially rock and cement, were much cheaper than now, and for that reason the cost of the work was brought down quite low.

The cost of the work was as follows:

Excavation:	
Slopes, 8,912 cubic yards, at 44.7 cents per yard	$3,983.66
Works, 4,234 cubic yards, at 42.3 cents per yard	1,790.98
Fill:	
4,245 cubic yards, at 38.4 cents per yard	1,630.07
Concrete:	
Traverse and parapet—	
Concrete, 3,674 cubic yards, at $4.23	15,541.10
Rubble, 330 cubic yards, at $2.65	874.50
Platforms, 583 cubic yards, at $4.56	2,658.48
Forms for concrete	3,213.94
Plastering and paraffin painting	246.92
Grading, loaming, and seeding slopes (U)	540.70
Drains and ventilation (U)	308.60
Doors and hangings (U)	398.00
Concrete sidewalk finish, 4,575 square feet, at 15 cents	686.25
Anchor bolts	152.58
Steel beams for magazine roofs	450.58
Speaking tubes	24.57
Total	32,500.93

Besides the items marked U (unfinished), there are the steps, cranes, and trolleys to go in and asphalt finish to be put on.

The reduction of concrete over the estimate is due to the fact that wherever rock was encountered in the masses of concrete it was left in place, and also to the building of less of Emplacement No. 7 than was intended at the time the estimate was made.

Emplacements 18 and 19.—These emplacements are nearly finished, the remaining work being to concrete the terrepleins, fence the battery, put in machinery, hang doors, and put on asphalt finish.

The cost of the work is as follows:

Excavation, 6,636 cubic yards, at 61 cents	$4,047.96
Fill, 7,135 cubic yards, at 44.9 cents	3,203.52
Concrete:	
Traverse and parapet—	
4,300 cubic yards, at $4.24	18,232.00
Rubble, 260 cubic yards, at $3.14	816.40
Gun platforms, 276 cubic yards, at $5.73	1,581.48
Forms for concrete	2,425.60
Setting 2 base rings and finishing platforms	262.24
Grading, loaming, and seeding slopes	950.00
Drains and ventilation	965.43
Steel beams	653.04
Plastering and paraffin painting	277.21
Anchor bolts	137.27
Speaking tubes	40.09
Doors and hangings (U)	429.79
Sidewalk finish, 2,928 square feet, at 12.3 cents	360.14
Wooden steps	44.97
Cement washing	42.00
Total	34,469.14

Improvements at Emplacements 11 to 16.—The terrepleins at Nos. 15 and 16 are done; the three manholes to the counterweight wells Nos. 11–13 are done; the excavation for the guard and relocator rooms at No. 14 is done.

The expenditures have been as follows:

Three manholes	$139.30
Concrete for terrepleins, 120 cubic yards, at $4.53	543.60
Cement finish, 3,264 square feet, at 5 cents	163.20
Setting base ring at No. 14	115.87

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Guardroom:	
Excavation, 310 cubic yards, at 90 cents	$279.00
Forms	83.00
Steel beams	131.40
Concrete, 27 cubic yards, at $6	162.00
Total	1,617.37

Incidental expenses.

Cement shed	698.63
Repairs to buildings	455.28
Tool house	133.09
Repairs to water supply	837.62
Concrete plant	4,124.49
Resetting same at Emplacements Nos. 18 and 19	984.39
Dismounting 15-inch guns	164.00
Cement testing	701.91
Repairs to roads	3,183.99
Repairs to carts, wagons, and tools	410.23
General blacksmithing	1,850.00
Heating, lighting, and care of quarters	850.00
Stable supplies, care of stables, and feeding Government horses	1,595.39
Scraping sand for Emplacements Nos. 9 and 10	228.22
Survey of new batteries	102.00
Mounting guns and shipping gun carriage	687.00
Tools	790.21
Office expenses	5,799.04
Holidays and Sunday watchman	1,055.00
Total	24,650.49
As a total result we have the following:	
Emplacement No. 8	32,500.93
Emplacements Nos. 18 and 19	34,469.14
Improvements Nos. 11–16	1,617.37
Incidentals	24,650.49
Total cost	93,237.93

The cost of excavation is above what it would have been had the season been more favorable. The original cost of the plant was largely increased by an attempt to use some old machinery on hand which had to be discarded and new machinery purchased.

The item for repair to roads is very large on account of the fact that the reservation roads cut up badly during the winter rains and had to be planked in order to carry on the work, and after the work was finished it was necessary to cover the road for several hundred feet with macadam.

EMPLACEMENTS 9 AND 10.

Work was started early in June, and at the end of the month the excavation was finished and a portion of the concrete of the floors put in, the plant partially put up, and some forms made.

The expenditures are as follows:

Excavation	$2,085.12
Setting up plant	415.02
Forms for concrete	420.11
Cement, cost and storage	11,057.97
Concreting	48.00
Drains	88.06
Scraping sand	99.55
Back filling	60.00
Office expenses	475.00
Steel beams	968.65
Forage, shoeing, and repairs	109.21
Total	15,826.69

MORTAR BATTERY NO. 2.

Work was begun in June, and the expenditure of $266.25 was for clearing site and laying out the work.

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3 V.

DEFENSES OF MOUTH OF COLUMBIA RIVER.

Officer in charge, Capt. Walter L. Fisk, Corps of Engineers, with Lieut. Clement A. F. Flagler, Corps of Engineers, under his immediate orders; Division Engineer, Col. Charles R. Suter, Corps of Engineers.

The projected work under these allotments comprises at present four emplacements for 10-inch B. L. rifles on disappearing carriages (three L. F., model 1894, one L. F., model 1896), two emplacements for 8-inch B. L. rifles on disappearing carriages, L. F., model 1896, and two mining casemates.

A provisional allotment from appropriation for gun and mortar batteries, act of June 6, 1896, was made June 30, 1896, to cover all of the above project, except one 10-inch emplacement and the two mining casemates. The excepted 10-inch emplacement was included in the allotment of $258,000 on November 5, 1896, on recommendation from this office to the effect that such an emplacement could be constructed within the original allotment without increase. Allotments of 6,000 and 7,500 were made on November 5 and 13, respectively, from the appropriation for torpedoes for harbor defense, acts of March 2, 1895, and June 6, 1896, for the mining casemates. An allotment of $500 from appropriation for gun and mortar batteries, act of June 6, 1896, was made February 11 for the construction of manholes in three of the 10-inch emplacements.

Ten-inch gun battery.—Plans and estimates submitted for the construction of Emplacements Nos. 2, 3, and 4 were approved November 5, but work began before this date, under permission granted from the Office of the Chief of Engineers, under date of September 1, 1896.

Authority having been granted to use for this work the plant of the improvement of the mouth of the Columbia River (comprising wharf, quarters, shops, storehouses, hoisting engines, pumps, locomotives, cars, tracks, steam tug, and barges), it was necessary to construct only a plant for mixing and placing concrete and for receiving and storing materials. This plant comprised a double concrete mixer, consisting of 2 cubical steel boxes, 4 feet on the edge, with necessary machinery for operating, 4 iron hoisting buckets capable of handling one charge at a load, 12 steel mining cars for placing concrete, and all necessary tools for mixing, handling, and finishing concrete.

A steam shovel was purchased from the Marion Steam Shovel Company, of Marion, Ohio, for the purpose of excavating sand for the fill in the parapet and parados of the battery. The shovel is a 35-ton shovel, with dipper of 1½ cubic yards capacity, and cost $5,000 at the factory. It is guaranteed to a capacity of 1,000 cubic yards in eight hours, and has excavated on this work as high as 1,400 cubic yards in such a day.

Extensive changes were necessary in the Columbia River plant; adapting the barges and railroad cars for carrying crushed rock and sand, arranging dump cars for the sand fill, etc. It was also necessary to build a mixer house, 76 feet high, to lay railroad tracks to the battery in front and rear, and to construct an inclined railroad trestle, rising to a height of 20 feet above the ground for carrying materials to the plant. The rails used for this track were taken up from the jetty tramway.

All the above plant except the steam shovel was in place and concreting commenced October 20. It was carried on nearly continuously from this date until March 3, 1897, when all of the concrete for Emplace-

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ments Nos. 1, 2, 3, and 4 was in place, excepting that for the electric-light station and certain small retaining walls and road gutters.

These four months of construction are the worst of the Oregon rainy season; most of the laying of concrete and a part of the construction of the plant was carried on in nearly constant rain and cold winds of high velocity. All of the workmen were compelled to wear rubber or oilcloth the greater part of the time. It was impossible to work the men to the best advantage, and sickness, resulting from exposure, continually interfered with the work. Only one death from these causes occurred, but as high as 13 men out of a force of 160 were sick at one time with la grippe and pneumonia. During a portion of this time work was carried on for eleven hours a day. This pressure was necessary to carry out instructions from the Chief of Engineers that the platforms of these emplacements must be ready for their carriages by December 1, 1896.

Concrete plant (see sheet 3,* tracing, herewith).—This plant consisted of two 4-foot cubical boxes, with necessary gearing, shafts, etc., driven by a Mundy 36-horsepower hoisting engine. Materials were transported from the rock and sand bunkers in large iron hoisting buckets resting on cradles on flat cars drawn by one horse. The cement was added to the charge in the bucket just before hoisting, from either of the two cement chutes shown. The bucket was then hoisted to the top, run along the inclined rail on its trolley carriage until over the proper cradle, lowered to its cradle, and when ready dumped into the hopper over the mixer box. The charge consisted of 24 cubic feet of crushed rock, 9 cubic feet of sand, 3 of cement, and 18 gallons of water. After closing the box it was given 15½ turns and emptied into two steel mining cars of 20 cubic feet capacity, capable of dumping over the side or end. These cars were run out by hand on a tramway 3 feet above the highest reference of the concrete and the concrete dumped in place. Great care was needed in regulating the amount of water used in a charge to correspond with the amount of rain falling at the time. This plant mixed easily 200 cubic yards in eight hours. The largest amount mixed in one day was 225 cubic yards.

Concrete materials.—The cement used was imported Portland cement of two brands—North's Condor and Josson's Niel-on-Ruppel cement. The first was purchased from Balfour, Guthrie & Co., of Portland, Oreg., in two lots—the first, an open-market purchase, at $2.18 per barrel, the second, by contract, at $2.50 per barrel. The Josson cement was furnished by contract with W. P. Fuller & Co., of Portland, Oreg., at $2.18 per barrel.

The rock was a black basalt quarried at Mount Coffin, just below the mouth of the Cowlitz River on the Columbia and 55 miles above Fort Stevens. It weighs 184 pounds to the cubic foot and breaks naturally when blasted into pieces weighing from 25 to 200 pounds. It was quarried, crushed, and delivered on Government barges at the quarry by contract with Daniel Kern, of Portland, Oreg., for 65 cents per cubic yard. This stone was furnished in three sizes—large (100 to 500 pounds), crushed to 2-inch size, and granolithic—all furnished at the same price. The crusher used was at first a Blake, but afterwards a Gates was substituted.

The sand used was a very good coarse sand (known in this vicinity as Columbia River gravel). It was dredged from the bottom of the Columbia River near Fishers Landing, Wash., deposited on Government barges, and the barges towed 48 miles down the river to Stella, a

* Omitted.

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town on the Washington shore, 52 miles above Fort Stevens, and anchored there to await the Government tug. This sand was furnished as above for 35 cents per cubic yard by contract with Ham, Nickum & Co., of Portland, Oreg.

The rock and sand after delivery on Government barges at Mount Coffin and Stella was towed to the wharf by the United States tug *Geo. H. Mendell* (mouth of Columbia River appropriation), loaded on dump cars by two steam derricks, and hauled by locomotives to the bunkers provided near the mixer.

The cost of handling these materials was as follows:

	Towing.	Handling.	Total cost.
Cement ..... per barrel..	.....	$0.05	$0.05
Rock ..... per cubic yard..	$0.326	.39	.716
Sand ..... do....	.326	.26	.586

The cost of concrete in place, including large rock embedded, was, considering only materials and labor of mixing and placing, $3.75 per cubic yard. Adding the proportionate cost of plant, forms, repairs, engineering, superintendence, and office work, the cost becomes $5.90 per cubic yard.

The materials used in construction and plant, other than concrete, were purchased under sealed proposals as follows:

Articles.	Amount.	Purchased from—	Price.	Delivered at—
Steel I-beams.....tons..	28¼	Carnegie Steel Co.....	1.85/100 cents per pound..	Pittsburg, Pa.
Steel I beams.....do....	8	Pacific Rolling Mills..	2½ cents per pound....	Astoria, Oreg.
Bearing plates.....do....	10	Carnegie Steel Co.....	1½ to 3 cents per pound.	Pittsburg, Pa.
Bearing plates.....do....	3	Smith & Watson Iron Works, Portland, Oreg.	2¾ to 3 cents per pound.	Astoria, Oreg.
Trolleys, rails, etc., for 4 emplacements.	.....	Brown Hoisting and Conveying Co., of Cleveland, Ohio.	$1,706.67.....	Cleveland, Ohio.
Crane collars.....	12	American Iron Works, of Portland, Oreg.	$5.62 each.....	Astoria, Oreg.
Cranes.....	15	Willamet Iron Works, of Portland, Oreg.	$28.42 each.....	Do.
Anchorage bolts.....	132	Wolff & Zwicker Iron Works, of Portland, Oreg.	$870 per lot.....	Do.
Anchorage bolts.....	16	American Iron Works, of Portland, Oreg.	$98.09 per lot.....	Do.
Hinge blocks, basalt.....	140	Geo. Bamford, of Portland, Oreg.	$1.65 each.....	Portland, Oreg.
Hinge gudgeons and pins, gun metal.	172	Francis Bros., of Portland, Oreg.	18 cents per pound....	Do.
Lumber, rough, surfaced, and flooring.	.....	Oregon Pine Lumber Co., Clatsop Mill Co., H. B. Borthwick.	$5.99 to $14.98 per M..	Astoria and Fort Stevens.
Concrete cars.....	12	Joshua Hendy & Co., of San Francisco, Cal.	$60 each	Fort Stevens.
Hoisting buckets.....	4	Wolff & Zwicker Iron Works, of Portland, Oreg.	$46.75 each.....	Do.
Mixer and gears....set..	1	Smith & Watson Iron Works, of Portland, Oreg.	$500.....	Do.

About the middle of December the steam shovel was received and moved to the site from which it was expected to obtain sand. From this site a track was built, as shown on accompanying tracing,* to the parados in rear of battery. This track is at grade for 2,200 feet, it then

* Omitted.

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begins to rise from the ground at a grade of 1 on 75 until it reaches the parapet, when it is at the reference (40). A switch is put in this trestle track before reaching the parados, enabling the track to run along each side of the parados at the above height; in this track there is 2,728 feet of single-track trestle. In addition to the above trestle, a short steep trestle was constructed, connecting the parados with the railroad trestle, for delivery of concrete materials, and later on (in February) a trestle running along the entire front of the battery, for depositing sand in the parapet, and connecting with the above trestle running to the parados. This parapet trestle crossed the material trestle to the mixer at so low a level as to necessitate a bascule bridge in the parapet track (shown on photograph No. 58). The steam shovel began excavating January 18, and from that date has deposited in the fills of the battery 90,140 cubic yards. This amount has completed the parapet fill, and has carried the parados fill up to the reference (40). Above this height it will be necessary to build additional trestle work. All of the sand deposited was sluiced with a water jet from a 1¼-inch nozzle to render it compact. This sluicing reduced its volume by car measurement about one-third. The cost of fill per cubic yard (car measurement) was 19¼ to 19½ cents. This includes cost of shovel, trestles, tracks, etc.

The cost of other items in construction was as follows:

Granolithic finish, 17 cents per square foot.
Interior side-wall plastering, 2¾ cents per square foot.
Interior overhead plastering, 8 cents per square foot.
Exterior plastering, 2¾ cents per square foot.
Sidewalk finish for floors, 9½ cents per square foot.

Three 10-inch disappearing carriages, L. F., model 1894 (Kilby Nos. 3, 4, and 5), and three 10-inch B. L. rifles were received during the year. The carriages have been mounted in Emplacements Nos. 2, 3, and 4, respectively, and the guns are now being mounted.

The cement received was tested for fineness and for the presence of free lime, samples for test being taken from every tenth barrel received. A few samples of the cement used were also sent to the Cascade Locks and tested for tensile strength. All tests were satisfactory.

On July 1, 1897, there remains to be done, under existing allotment, the following:

1,190 feet of roadway and drain.
Steel cover to observing station.
24 doors.
117,000 square feet of slope protection.
Electric-light plant and fixtures.
Water supply.

Mining casemate.—Work on this allotment was begun in April, 1897, and is now in progress. A railroad trestle 1,200 feet long, rising to a reference of (32), was constructed for transporting materials to the site of the casemate. All the concrete work except the open trench is completed. The exterior plastering is complete. There remains to be done the construction of the open concrete trench, the passage of the jetty, interior plastering, fill, slope protection, doors, and electric lights. One thousand two hundred and sixty-seven cubic yards of soil have been excavated and 489 cubic yards of concrete laid.

8-inch gun battery.—Operations have up to date been only preliminary, except as regards the excavation, which is now complete for Emplacements Nos. 1 and 2. The first requisite for construction was a wharf for the landing of materials.

The site of the wharf, facing as it does the entrance to the mouth of

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the Columbia River, is exposed to a heavy ocean swell which rushes in through the channel. This swell is of such height that it has been known to break in 20 feet of water. The entire shore of the reservation is exposed to it, and the construction of a wharf is thus rendered a difficult problem. To insure safety to rock and sand barges lying at the wharf, it is necessary to have at the wharf head a depth of 24 feet at low water. To obtain this depth a wharf nearly half a mile long was required. The position of the wharf is shown on the accompanying tracing,* sheet 5.

Authority was obtained from the Chief of Engineers, under date of November 17, 1896, to construct such a wharf at a cost of not more than $12,000. Bids for its construction by contract were opened December 10, 1896, and the contract awarded to Maney & Goerig, of Astoria, the lowest of eight bidders. The accepted bid was as follows:

Piles, in place and cut, 10 cents per linear foot.
Lumber, in place, $10.50 per 1,000 feet B. M.
Cast iron, in place, 3½ cents per pound.
Wrought iron, in place, 3 cents per pound.

The contract provided for completion of the wharf on or before March 1, 1897.

The contractors began work December 23, 1896, with a floating pile driver, on the shore end of the approach. On December 29 the driver was torn from its moorings by the swell and washed ashore above the reservation. A raft of 75 piles was carried away at the same time and lost. After several unsuccessful attempts to get the scow from the beach, she was hauled off by the United States Engineer tug *G. H. Mendell* on January 5, 1897. On January 14 the driver, having been repaired, was started at work on the head of the wharf. Very slow progress was made, owing to severe weather. Most of the rafts of piles awaiting driving broke loose and were scattered along the beach and Sand Island. Most of them were recovered, but a large number were lost. On January 26 the pile driver was upset in a storm, and no further work done until February 8. All the piles for the head of the wharf were driven by February 24. Seventeen piles in the head of the wharf were broken off at the level of the bottom by vibrations caused by the strong ebb tide. March 1 an overhead pile driver, which had been constructed upon the wharfhead under demand from this office, was put to work. The floating driver returned to work at the shore end. The floating driver could work only during ebb tide, and the overhead driver could work only during flood, as the strong ebb tide would tear the piles out of the guides. The floating driver was upset again in a storm on March 25 and the boiler, engine, and hammer went to the bottom. They were recovered in a few days and work resumed.

The wharf was completed May 1, 1897, two months after the time specified. This delay was covered by two extensions of one month each, granted the contractors as being to the best interest of the United States. Cost of inspection during extensions was borne by the contractors, as it was thought by this office that they had not made every effort to complete within the time specified. The weather was little, if any, worse than had been expected, and the contractors' plant until March 1 was utterly inadequate.

The dimensions of the wharf are as follows:

Wharfhead 194 feet by 50 feet, with 72 supporting and 92 fender piles.
Approach, 2,378 feet long, 82 feet of which is a Howe truss over the rocky shore, where piles could not be driven.
All piles were driven 14 feet into the bottom.
The average number of blows for each pile was 62 from a 3,000-pound hammer.

* Omitted.

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The cost of the wharf was $10,867.64.

The wharf not being completed on March 1, as per contract, arrangements were made for landing lumber, etc., on the beach for the construction of temporary quarters, storehouses, etc. On March 5 nine men with one team were landed and set to work clearing, making roads, etc. This force has been gradually increased until the present time, when it is about 100.

All the necessary quarters, shops, office, storehouses, mess houses, railroad tracks and trestles, etc., have been erected. A dam was thrown across Scarboro Creek at an elevation of 327 feet, and a supply of good water brought by flume to a reservoir of capacity of 50,000 gallons constructed behind the battery at a height of 186 feet. From this reservoir it is piped under pressure to different parts of the work.

The concrete plant is now completed, and will soon begin mixing concrete. A section of this plant is shown on sheet 5,* accompanying tracing. It consists of a single steel 4-foot cubical box mixer, a vertical engine of 25 horsepower (taken from the old tug *Humphreys*), an 80-horsepower horizontal boiler (to be used afterwards for electric plant), and a hoisting drum. The charge cars will be hauled by the drum up an incline 700 feet long from the rock and sand bunkers at the foot of the hill. They will dump directly into the mixer, and the mixed concrete will be run out on a tramway in the same concrete cars used at Point Adams.

Materials.—Rock is the same as that used in the 10-inch battery, and delivered under the same contract. Sand is delivered in the same manner as for the 10-inch battery, and by the same firm—Ham, Nickum & Co., of Portland—at 32½ cents per cubic yard, but is now obtained from the Sandy River. The cement is North's Condor and K. B. and S., both brands furnished by Balfour, Guthrie & Co., of Portland, at $2.50 per barrel.

The excavation is complete over the site of Emplacements Nos. 1 and 2. This excavation was effected by blasting and scraping with 2-horse drag scrapers. The total amount excavated for the emplacements was 10,905 cubic yards, 1,500 cubic yards of which was solid rock. The average cost per yard of this excavation was 53.7 cents.

Materials for construction other than concrete were as follows:

Article.	Amount.	Purchased from—	Price.	Delivered at—
I-beams.....tons..	18½	Carnegie Steel Co.....	2½ cents per pound.	Astoria, Oreg.
Trolley rails, etc. (for emplacements).	2	New Jersey Foundry and Machine Co., of New York.	$510.....	New York, N.Y.
Crane collars	4	Wolff & Zwicker Iron Works, of Portland, Oreg.	21 cents per pound..	Astoria, Oreg.
Cranes.....	4	Willamet Iron Works, of Portland, Oreg.	$28.42 each.....	Do.
Anchorage bolts.....	25	Wolff & Zwicker Iron Works, of Portland, Oreg.	$108.....	Do.
Hinge blocks, cut basalt.	24	Geo. Bamford, of Portland, Oreg.	$1.65 each	Portland, Oreg.
Lumber, rough, surfaced, and flooring.	.....	Clatsop Mill Co., H. B. Borthwick.	$6 to $14 per 1,000 feet.	Astoria, Oreg.
80-horsepower boiler.....	1	Chas. Gauld, of Portland, Oreg.	$850.....	Do.
Lift fixtures (sheaves, brackets, etc., for emplacements).	2	American Iron Works, of Portland, Oreg.	$267.83	Do.

The instructions of the Chief of Engineers accompanying the provisional allotment of $258,000 were that emplacements for two 8-inch

* Omitted.

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guns should be finished by July 1, 1897. Every effort has been made to accomplish this, but the delay of the contractors in completing the wharf held the work back for two months and rendered completion on the date specified impossible. The platforms will be completed and the emplacements largely so before the lapse of two months from the present date.

Mining casemate.—Plans and estimates for the construction of this casemate were approved March 17, 1897, but no work has yet been done upon it. The I-beams, cement, sand, and rock for its construction have been delivered.

Money statements.

GUN AND MORTAR BATTERIES.

June 30, 1896, amount allotted	$258,000.00	
February 11, 1897, amount allotted	500.00	
		$258,500.00
June 30, 1897, amount expended during the fiscal year		181,096.59
July 1, 1897, balance unexpended		77,403.41
July 1, 1897, outstanding liabilities	$16,551.59	
July 1, 1897, amount covered by existing contracts	650.00	
		17,201.59
July 1, 1897, balance available		60,201.82

TORPEDOES FOR HARBOR DEFENSES.

First mining casemate.

November 13, 1896, amount allotted	$7,500.00
June 30, 1897, amount expended during fiscal year	1,024.16
July 1, 1897, balance unexpended	6,475.84
July 1, 1897, outstanding liabilities	1,451.02
July 1, 1897, balance available	5,024.82

Second mining casemate.

November 5, 1896, amount allotted	$6,000.00
July 1, 1897, balance unexpended	6,000.00
July 1, 1897, outstanding liabilities	74.03
July 1, 1897, balance available	5,925.97

Abstracts of proposals for furnishing and delivering Portland cement received in response to advertisement of August 14, and opened at Portland, Oreg., on August 26, 1896, by Capt. W. L. Fisk, Corps of Engineers.

No.	Name and address of bidder.	Number of barrels.	Price.	Total.
1	W. P. Fuller & Co., Portland, Oreg	3,000	$2.18	$6,540.00
2	Balfour, Guthrie & Co., Portland, Oreg	11,000	2.34	25,740.00
3	The J. McCraken Co	5,500	2.50	13,750.00

Contract awarded to W. P. Fuller & Co., and executed under date of September 11, 1896.

Abstracts of proposals for furnishing and delivering broken stone, opened September 2, 1896, by Capt. W. L. Fisk, Corps of Engineers.

No.	Name and address of bidder.	Class 1 (2,500 cubic yards).	Class 2 (12,500 cubic yards).	Class 3 (85 cubic yards).	Aggregate.	Place of delivery.
1	Wakefield & Jacobsen, Portland, Oreg.	$0.71	$0.71	$0.78	$10,716.30	St. Helen, Oreg.
2	Daniel Kern, Portland, Oreg.	.65	.65	.65	9,805.25	Mount Coffin, Wash.
3	Star Sand Co., Portland, Oreg.	.65	.75	.85	11,072.25	Cole's Quarry, below Stella, Wash.

Contract awarded to Daniel Kern, and executed under date of September 4, 1896.

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Abstracts of proposals for constructing a wharf, opened at Portland, Oreg., on December 10, 1896, by Capt. W. L. Fisk, Corps of Engineers.

No.	Name and address of bidder.	Piles (30,000 feet).	Lumber (524 M.).	Wrought iron (20,000 pounds).	Cast iron (5,000 pounds).	Total.
		Per foot.	*Per M.*	*Per pound.*	*Per pound.*	
1	Paquet & Smith, Portland, Oreg	$0.11\frac{1}{2}$	$11.50	$0.04	$0.03\frac{1}{2}$	$10,451.00
2	Robt. Wakefield, Portland, Oreg	$.10\frac{1}{2}$	12.00	$.04\frac{1}{2}$	$.03\frac{1}{2}$	10,463.00
3	Hamilton & Muir, Portland, Oreg	.10	14.50	$.02\frac{1}{2}$	.03	11,248.00
4	J. A. Fastocend, Astoria, Oreg	$.10\frac{3}{4}$	11.75	$.04\frac{1}{2}$	$.04\frac{1}{2}$	10,444.50
5	Maney & Goerig, Astoria, Oreg	.10	10.50	$.03\frac{1}{2}$	.03	9,302.00
6	Leback & Sanderson, Astoria, Oreg	.10	12.00	$.03\frac{1}{2}$	$.03\frac{1}{2}$	10,163.00
7	Clinton & Co., Astoria, Oreg	.10	10.50	.04	.04	9,502.00
8	Geo. W. Martin & Co., Portland, Oreg	$.09\frac{7}{10}$	14.40	$.04\frac{5}{8}$	$.03\frac{1}{2}$	11,473.10

Contract awarded to Maney & Goerig, and executed under date of December 10, 1896.

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3 W.

DEFENSES OF PUGET SOUND.

Officer in charge, Capt. Harry Taylor, Corps of Engineers; assistant, Lieut. M. L. Walker, Corps of Engineers, since January 15, 1897; Division Engineer, Col. C. R. Suter, Corps of Engineers.

The operations during the year have been confined to obtaining the title to the different sites upon which fortifications are to be built; to the preparation of plans and specifications, and advertising the work to be done by contract.

Two sites were obtained, partly by purchase and partly by condemnation, and negotiations are in progress for the purchase of as much as possible of a third site. This site will be obtained partly by purchase and partly by condemnation.

Plans were prepared and approved for the batteries to be built on the sites acquired during the year.

May 26, 1897, advertisements were issued for the construction by contract of a battery of six emplacements. Proposals for this work were received and opened June 30, 1897.

June 23, 1897, proposals were received for the construction by contract of four emplacements of a second battery.

Money statements.

SITES FOR FORTIFICATIONS AND SEACOAST DEFENSES.

For surveys and incidental expenses:	
July 1, 1896, balance available	$395.87
Allotted since	650.74
	1,046.61
June 30, 1897, amount expended during fiscal year	1,036.93
	9.68
June 30, 1897, outstanding liabilities	5.10
July 1, 1897, balance available	4.58

Site No. 1.

November 7, 1896, amount allotted	$3,480.00
June 30, 1897, amount expended during fiscal year	900.00
July 1, 1897, amount unexpended	2,580.00
July 1, 1897, outstanding liabilities	2,580.00

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Site No. 2.

October 27, 1896, amount allotted	$7,200.00
June 30, 1897, amount expended during fiscal year	7,200.00

Site No. 3.

March 13, 1897, amount allotted	43,075.00

GUN AND MORTAR BATTERIES.

Amount allotted during fiscal year	1,850.00
June 30, 1897, amount expended during fiscal year	1,670.14
July 1, 1897, balance unexpended	179.86
July 1, 1897, outstanding liabilities	90.00
July 1, 1897, balance available	89.86

An abstract of proposals opened June 30, 1897, for construction of gun emplacements, is herewith.

Abstracts of proposals for constructing gun emplacements.

Items	Quantity.	1. Charles E. Cotton, Oakland, Cal., and Wm. H. Healy, San Francisco.		2. Hugh Fay, Seattle, Wash.		3. Charles A. Gray and W. D. Pugh, Salem, Oreg.	
		Bid.	Amount.	Bid.	Amount.	Bid.	Amount.
Clearing ..... acres..	28	$90.00	$2,520.00	$150.00	$4,200.00	$184.00	$5,152.00
Excavation ..... cubic yards..	178,400	.26	46,384.00	.27½	49,060.00	.26	46,384.00
Concrete:							
No. 1 ..... do....	500	7.70	3,850.00	7.50	3,750.00	9.25	4,625.00
No. 2 ..... do....	2,400	6.20	14,880.00	5.75	13,800.00	7.50	18,000.00
No. 3 ..... do....	15,900	4.60	73,140.00	5.25	83,475.00	6.50	103,350.00
Granolithic surfacing..sq. yds.	4,500	.90	4,050.00	.30	1,350.00	.81	3,645.00
Whitewashing ..... squares..	400	.30	120.00	.15	60.00	.40	160.00
Broken stone for blind drains, cubic yards	150	2.95	442.50	3.00	450.00	2.50	375.00
Large rock ..... tons..	750	2.95	2,212.50	2.65	1,987.50	2.60	1,950.00
Steel beams, etc ..... pounds..	154,000	.04	6,160.00	.02½	3,850.00	.03½	5,390.00
Cast-iron drainpipe:							
8-inch ..... linear feet..	1,150	.90	1,035.00	.75	862.50	.85	977.50
6-inch ..... do....	460	.80	368.00	.50	230.00	.45	207.00
Tile drainpipe, 6 inch ... do....	1,500	.12	180.00	.10	150.00	.10	150.00
Galvanized wrought-iron pipe:							
2½-inch ..... linear feet..	560	.25	140.00	.20	112.00	.15	84.00
2-inch ..... do....	400	.18	72.00	.15	60.00	.12	48.00
1½-inch ..... do....	3,400	.13	442.00	.10	340.00	.10	340.00
Cast-iron manholes, gratings, etc ..... pounds..	3,500	.04	140.00	.03	105.00	.05	175.00
Doors, steel double-leaf:							
6 by 8 feet	6	100.00	600.00	50.00	300.00	59.00	354.00
4 by 8 feet	6	94.00	564.00	45.00	270.00	54.00	324.00
Doors, steel single-leaf:							
4 by 8 feet	24	60.00	1,440.00	40.00	960.00	51.00	1,224.00
3 by 8 feet	20	55.00	1,100.00	30.00	600.00	49.00	980.00
Cranes	12	175.00	2,100.00	125.00	1,500.00	127.00	1,524.00
Lifts, double ..... pairs..	12	750.00	9,000.00	550.00	6,600.00	590.00	7,080.00
Trolley track ..... pounds..	19,000	.08	1,520.00	.06	1,140.00	.06	1,140.00
Trolleys	24	70.00	1,680.00	50.00	1,200.00	29.00	696.00
Steel anchor bolts .... pounds..	8,400	.08	672.00	.06	504.00	.06	504.00
Cast-iron anchor plates .. do....	4,200	.08	336.00	.03	126.00	.04	168.00
Miscellaneous iron ..... do....	1,000	.15	150.00	.12	120.00	.07	70.00
Asphalting .... square yards..	1,700	1.20	2,040.00	1.00	1,700.00	3.90	6,630.00
Piling:							
Summer cut } linear feet..	11,000	.11	.....	.16	.....	.15	.....
Winter cut }		.12	1,210.00	.16	1,760.00	.16	1,760.00
Lumber ..... feet B. M..	80,000	12.00	960.00	20.00	1,600.00	14.50	1,160.00
Iron ..... pounds..	7,000	.04	280.00	.05	350.00	.04	280.00
Total	.....	.....	179,898.00	.....	182,572.00	.....	214,906.50

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Abstracts of proposals for constructing gun emplacements—Continued.

Items.	Quantity.	4. Nichols & Crothers, Tacoma, Wash.		5. E. G. Griggs, Tacoma, Wash., and J. J. Maney, Everett, Wash.		6. Perry Hinkle and J. M. Nickum, Portland, Oreg.	
		Bid.	Amount.	Bid.	Amount.	Bid.	Amount.
Clearing.....acres..	28	$60.00	$1,680.00	$100.00	$2,800.00	$125.00	$3,500.00
Excavation.....cubic yards..	178,400	.26½	47,276.00	.32	57,088.00	.22	39,248.00
Concrete:							
No. 1.....do....	500	7.50	3,750.00	8.70 9.85	4,350.00 4,925.00	7.25	3,625.00
No. 2.....do....	2,400	6.25	15,000.00	7.20 8.35	17,280.00 20,040.00	6.50	15,600.00
No. 3.....do....	15,900	4.35	69,165.00	5.70 6.85	90,630.00 108,915.00	5.75	91,425.00
Granolithic surfacing, sq. yds..	4,500	.40	1,800.00	.12½	562.50	.90	4,050.00
Whitewashing.....squares..	400	.40	160.00	.50	200.00	1.00	400.00
Broken stone for blind drains, cubic yards.....:	150	1.50	225.00	3.50	525.00	2.00	300.00
Large rock.....tons..	750	1.30	975.00	3.00	2,250.00	3.00	2,250.00
Steel beams, etc.....pounds..	154,000	.04	6,160.00	.03½	5,005.00	.03½	5,390.00
Cast-iron drainpipe:							
8-inch.....linear feet..	1,150	1.00	1,150.00	.95	1,092.50	.75	862.50
6-inch.....do....	460	.80	368.00	.70	322.00	.60	276.00
Tile drainpipe, 6-inch...do....	1,500	.20	300.00	.14	210.00	.30	450.00
Galvanized wrought-iron pipe:							
2½-inch.....linear feet..	560	.30	168.00	.28	156.80	.30	168.00
2-inch.....do....	400	.25	100.00	.20	80.00	.25	100.00
1½-inch.....do....	3,400	.18	612.00	.16	544.00	.22	748.00
Cast-iron manholes, gratings, etc.....pounds..	3,500	.04	140.00	.06	210.00	.03½	122.50
Doors, steel double-leaf:							
6 by 8 feet.....	6	40.00	240.00	59.00	354.00	75.00	450.00
4 by 8 feet.....	6	30.00	180.00	54.00	324.00	60.00	360.00
Doors, steel single-leaf:							
4 by 8 feet.....	24	25.00	600.00	54.00	1,296.00	30.00	720.00
3 by 8 feet.....	20	20.00	400.00	50.00	1,000.00	25.00	500.00
Cranes.....	12	230.00	2,760.00	132.50	1,590.00	150.00	1,800.00
Lifts, double.....pairs..	12	680.00	8,160.00	500.00	6,000.00	500.00	6,000.00
Trolley track.....pounds..	19,000	.08	1,520.00	.12	2,280.00	.05	950.00
Trolleys.....	24	200.00	4,800.00	60.00	1,440.00	150.00	3,600.00
Steel anchor bolts....pounds..	8,400	.07	588.00	.09	756.00	.04	336.00
Cast-iron anchor plates..do....	4,200	.04	168.00	.06	252.00	.03	126.00
Miscellaneous iron.....do....	1,000	.12	120.00	.12	120.00	.03½	35.00
Asphalting.....square yards..	1,700	1.10	1,870.00	1.55	2,635.00	2.00	3,400.00
Piling:							
Summer cut Winter cut..linear feet..	11,000	.09 .09½	1,045.00	.10 .11½	1,265.00	.12 .15	1,650.00
Lumber.....feet B. M..	80,000	10.25	820.00	12.50	1,000.00	14.00	1,120.00
Iron.....pounds..	7,000	.06	420.00	.05	350.00	.03	210.00
Total.....	.....	.....	172,720.00	.....	203,967.80 225,587.80	.....	189,772.00

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Abstracts of proposals for constructing gun emplacements—Continued.

Items.	Quantity.	7. Heidmaier & Neu, Chicago, Ill.		8. H. C. Henry, Seattle, Wash., and H. E. Stevens, St. Paul, Minn.		9. J. G. Day, jr., Portland, Oreg.	
		Bid.	Amount.	Bid.	Amount.	Bid.	Amount.
Clearing.....acres..	28	$100.00	$2,800.00	$75.00	$2,100.00	$50.00	$1,400.00
Excavation.....cubic yards..	178,400	.40	71,360.00	.22	39,248.00	.29	51,736.00
Concrete:							
No. 1.....do....	500	9.85	4,925.00	7.50	3,750.00	8.50	4,250.00
No. 2.....do....	2,400	6.45	15,480.00	5.75	13,800.00	8.00	19,200.00
No. 3.....do....	15,900	5.50	87,450.00	4.75	75,525.00	7.00	111,300.00
Granolithic surfacing.sq.yds..	4,500	.75	3,375.00	.25	1,125.00	.90	4,050.00
Whitewashing.....squares..	400	.50	200.00	.50	200.00	.08	32.00
Broken stone for blind drains, cubic yards.....	150	2.00	300.00	1.50	225.00	1.00	150.00
Large rock.....tons..	750	1.50	1,125.00	2.75	2,062.50	1.50	1,125.00
Steel beams, etc.....pounds..	154,000	.03 $\frac{85}{100}$	5,929.00	.03½	5,390.00	.05½	8,470.00
Cast-iron drainpipe:							
8-inch.....linear feet..	1,150	.92	1,058.00	1.25	1,437.50	.50	575.00
6-inch.....do....	460	.75	345.00	1.05	483.00	.30	138.00
Tile drainpipe, 6-inch...do....	1,500	.35	525.00	.20	300.00	.45	675.00
Galvanized wrought-iron pipe:							
2½-inch.....linear feet..	560	.30	168.00	.30	168.00	.25	140.00
2 inch.....do....	400	.25	100.00	.25	100.00	.18	72.00
1½-inch.....do....	3,400	.25	850.00	.20	680.00	.12½	425.00
Cast-iron manholes, gratings, etc.....pounds..	3,500	.03½	122.50	.04¼	148.75	.05½	192.50
Doors, steel, double-leaf:							
6 by 8 feet.....	6	100.00	600.00	60.00	360.00	75.00	450.00
4 by 8 feet.....	6	85.00	510.00	50.00	300.00	70.00	420.00
Doors, steel, single-leaf:							
4 by 8 feet.....	24	55.00	1,320.00	45.00	1,080.00	70.00	1,680.00
3 by 8 feet.....	20	50.00	1,000.00	35.00	700.00	60.00	1,200.00
Cranes.....	12	125.00	1,500.00	90.00	1,080.00	150.00	1,800.00
Lifts, double.....pairs..	12	400.00	4,800.00	480.00	5,760.00	700.00	8,400.00
Trolley track.....pounds..	19,000	.05	950.00	.05½	1,045.00	.06	1,140.00
Trolleys.....	24	65.00	1,560.00	55.00	1,320.00	50.00	1,200.00
Steel anchor bolts....pounds..	8,400	.08	672.00	.05¼	441.00	.07	588.00
Cast-iron anchor plates.do....	4,200	.04	168.00	.04½	189.00	.07	294.00
Miscellaneous iron.....do....	1,000	.10	100.00	.04	40.00	.06	60.00
Asphalting....square yards..	1,700	3.10	5,270.00	1.75	2,975.00	2.50	4,250.00
Piling:							
Summer cut. } linear feet..	11,000	.17½	.....	.10	.....	.07	.....
Winter cut.. }		.17½	1,925.00	.12	1,320.00	.07	770.00
Lumber.....feet B. M..	80,000	12.00	960.00	12.00	960.00	9.75	780.00
Iron.....pounds..	7,000	.04	280.00	.03	210.00	.06	420.00
Total.....	.....	.....	217,727.50	.....	164,522.75	.....	227,382.50

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Abstracts of proposals for constructing gun emplacements—Continued.

Items.	Quantity.	10. Daniel Kern, Portland, Oreg.		11. W. L. Prather, jr., Oakland, Cal.		12. California Construction Co., San Francisco, Cal.	
		Bid.	Amount.	Bid.	Amount.	Bid.	Amount.
Clearing.....acres..	28	$55.00	$1,540	$200.00	$5,600.00	$65.00	$1,820.00
Excavation.....cubic yards..	178,400	.21	37,464.00	.30	53,520.00	.24	42,816.00
Concrete:							
No. 1.....do....	500	8.00	4,000.00	16.00	8,000.00	7.08	3,540.00
No. 2.....do....	2,400	6.75	16,200.00	12.00	28,800.00	6.23	14,952.00
No. 3.....do....	15,900	5.25	83,475.00	9.00	143,100.00	5.38	85,542.00
Granolithic surfacing.sq.yds..	4,500	.18	810.00	.90	4,050.00	.90	4,050.00
Whitewashing.....squares..	400	.20	80.00	.25	100.00	.25	100.00
Broken stone for blind drains, cubic yards.....	150	1.75	262.50	10.00	1,500.00	1.25	187.50
Large rock.....tons..	750	1.75	1,312.50	4.00	3,000.00	2.15	1,612.50
Steel beams, etc.....pounds..	154,000	.023	3,542.00	.05½	8,085.00	.05½	8,085.00
Cast-iron drainpipe:							
8-inch.....linear feet..	1,150	.88	1,012.00	.90	1,035.00	.90	1,035.00
6-inch.....do....	460	.65	299.00	.80	368.00	.60	276.00
Tile drainpipe, 6 inch....do....	1,500	.10	150.00	.50	750.00	.15	225.00
Galvanized wrought-iron pipe:							
2½-inch.....linear feet..	560	.24	134.40	.90	504.00	.25	140.00
2-inch.....do....	400	.18	72.00	.80	320.00	.20	80.00
1½-inch.....do....	3,400	.14	476.00	.50	1,700.00	.15	510.00
Cast-iron manholes, gratings, etc.....pounds..	3,500	.04	140.00	.05	175.00	.05	175.00
Doors, steel, double-leaf:							
6 by 8 feet.....	6	53.00	318.00	90.00	540.00	48.00	288.00
4 by 8 feet.....	6	48.00	288.00	85.00	510.00	32.00	192.00
Doors, steel, single-leaf:							
4 by 8 feet.....	24	48.00	1,152.00	80.00	1,920.00	32.00	768.00
3 by 8 feet.....	20	44.00	880.00	70.00	1,400.00	24.00	480.00
Cranes.....	12	110.00	1,320.00	300.00	3,600.00	240.00	2,880.00
Lifts, double.....pairs..	12	500.00	6,000.00	1,200.00	14,400.00	640.00	7,680.00
Trolley track.....pounds..	19,000	.04	760.00	.08	1,520.00	.05½	1,045.00
Trolleys.....	24	30.00	720.00	100.00	2,400.00	15.00	360.00
Steel anchor bolts....pounds..	8,400	.04	336.00	.05	420.00	.10	840.00
Cast-iron anchor plates..do....	4,200	.03	126.00	.04	168.00	.05	210.00
Miscellaneous iron.....do....	1,000	.04	40.00	.07	70.00	.05	50.00
Asphalting....square yards..	1,700	2.30	3,910.00	3.00	5,100.00	2.25	3,825.00
Piling:							
Summer cut } .....linear feet.. Winter cut }	11,000	.10 / .10	1,100.00	.40 / .40	4,400.00	.13 / .15	1,650.00
Lumber.....feet B. M..	80,000	10.00	800.00	80.00	2,400.00	15.00	1,200.00
Iron.....pounds..	7,000	.03	210.00	.07	490.00	.04	280.00
Total.....	.....	.....	168,929.40	.....	299,945.00	.....	186,894.00

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Abstracts of proposals for constructing gun emplacements—Continued.

Items.	Quantity.	13. Pacific Bridge Company, Portland, Oreg.		14. Peter M. Coyne, Port Townsend, Wash.	
		Bid.	Amount.	Bid.	Amount.
Clearing.....acres..	28	$50.00	$1,400.00	$80.00	$2,240.00
Excavation.....cubic yards..	178,400	.25	44,600.00	.30	53,520.00
Concrete:					
No. 1.....do....	500	5.95	2,975.00	11.00	5,500.00
No. 2.....do....	2,400	4.84	11,616.00	5.80	13,920.00
No. 3.....do....	15,900	4.32	68,688.00	4.05	64,395.00
Granolithic surfacing.....square yards..	4,500	.40	1,800.00	.35	1,575.00
Whitewashing.....squares..	400	.25	100.00	.25	100.00
Broken stone for blind drains...cubic yards..	150	1.00	150.00	1.50	225.00
Large rock.....tons..	750	2.15	1,612.50	1.10	825.00
Steel beams, etc.....pounds..	154,000	.03	4,620.00	.03	4,620.00
Cast-iron drainpipe:					
8-inch.....linear feet..	1,150	.60	690.00	.75	862.50
6-inch.....do....	460	.45	207.00	.50	230.00
Tile drainpipe, 6-inch.....do....	1,500	.12	180.00	.30	450.00
Galvanized wrought-iron pipe:					
2½-inch.....do....	560	.25	140.00	.35	196.00
2-inch.....do....	400	.20	80.00	.25	100.00
1½-inch.....do....	3,400	.15	510.00	.20	680.00
Cast-iron manholes, gratings, etc....pounds..	3,500	.04	140.00	.09	315.00
Doors, steel, double-leaf:					
6 by 8 feet.....	6	65.00	390.00	57.00	342.00
4 by 8 feet.....	6	45.00	270.00	51.00	306.00
Doors, steel, single-leaf:					
4 by 8 feet.....	24	42.00	1,008.00	41.00	984.00
3 by 8 feet.....	20	35.00	700.00	38.00	760.00
Cranes.....	12	125.00	1,500.00	109.00	1,308.00
Lifts, double.....pairs..	12	790.00	9,480.00	505.00	6,060.00
Trolley track.....pounds..	19,000	.10½	1,995.00	.08	1,520.00
Trolleys.....	24	70.00	1,680.00	63.00	1,512.00
Steel anchor bolts.....pounds..	8,400	.06	504.00	.07	588.00
Cast-iron anchor plates.....do....	4,200	.04	168.00	.05	210.00
Miscellaneous iron.....do....	1,000	.05	50.00	.12	120.00
Asphalting.....square yards..	1,700	1.90	3,230.00	1.35	2,295.00
Piling:					
Summer cut	11,000	.13	.....	.16	.....
Winter cut.....linear feet..		.15	1,650.00	.16	1,760.00
Lumber.....feet B. M..	80,000	13.00	1,040.00	16.50	1,320.00
Iron.....pounds..	7,000	.04	280.00	.04½	315.00
Total.....	.....	.....	163,453.50	.....	169,153.50

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RIVERS AND HARBORS, ETC.

APPENDIX A.

IMPROVEMENT OF RIVERS AND HARBORS IN MAINE AND NEW HAMPSHIRE.

REPORT FOR THE FISCAL YEAR ENDING JUNE 30, 1897, WITH OTHER DOCUMENTS RELATING TO THE WORKS. OFFICERS IN CHARGE, LIEUT. COL. A. N. DAMRELL AND MAJ. R. L. HOXIE, CORPS OF ENGINEERS.

IMPROVEMENTS.

1. Lubec Channel, Maine.
2. Moosabec Bar, Maine.
3. Narraguagus River, Maine.
4. Breakwater from Mount Desert to Porcupine Island, Bar Harbor, Maine.
5. Harbor at Sullivan Falls, Maine.
6. Union River, Maine.
7. Bagaduce River, Maine.
8. Penobscot River, Maine.
9. Belfast Harbor, Maine.
10. Camden Harbor, Maine.
11. Rockland Harbor, Maine.
12. Carvers Harbor, Vinal Haven, Maine.
13. Georges River, Maine.
14. Kennebec River, Maine.
15. Sasanoa River, Maine.
16. Portland Harbor, Maine.
17. Saco River, Maine.
18. Bellamy River, New Hampshire.
19. Cocheco River, New Hampshire.
20. Little Harbor, New Hampshire.
21. Removing sunken vessels or craft obstructing or endangering navigation.

EXAMINATIONS.

22. Chandlers River, Maine.
23. Union River near Ellsworth, Maine.
24. South channel of branch of Penobscot River, in Frankfort, Waldo County, Maine.
25. Boothbay Harbor, Maine.
26. Oyster River, New Hampshire.

SURVEYS.

27. St. Croix River, Maine.
28. Machias River, Maine.
29. Bangor Harbor and Penobscot River, including mouth of Kenduskeag River, Maine.
30. Harraseeket River, Maine.
31. Royal River, Maine.
32. Exeter River, New Hampshire.

UNITED STATES ENGINEER OFFICE,
Portland, Me., July 17, 1897.

GENERAL: I have the honor to forward annual report for the fiscal year 1897 for river and harbor works in my charge.

Very respectfully, your obedient servant,

R. L. HOXIE,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A

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A 1.

IMPROVEMENT OF LUBEC CHANNEL, MAINE.

The approved project and the report of progress of the work up to June 30, 1896, will be found in the Report of the Chief of Engineers for 1897, Part I, page 26.

The expenditures during the fiscal year 1897 were $16,982.51. The operations consisted in dredging under a contract which was in progress at the close of the fiscal year 1896, and which was completed on the 21st of July. The total quantity of material dredged under this contract was 120,000 cubic yards, about 100,000 cubic yards of which had been taken out previous to July 1, 1896. The channel was widened about 170 feet at the entrance, and about 150 feet at the turn just above Cranberry Point.

The improvements render less difficult the passage of a way which is subject to strong currents and frequent fogs.

There is a light-house about 1 mile to the southward of Lubec on the westerly side of the dredged channel. Lubec Narrows is in the collection district of Passamaquoddy.

Money statement.

July 1, 1896, balance unexpended		$49,161.07
June 30, 1897, amount expended during fiscal year		16,982.51
July 1, 1897, balance unexpended		32,178.56
July 1, 1897, outstanding liabilities	$150.00	
July 1, 1897, amount covered by uncompleted contracts	29,000.00	
		29,150.00
July 1, 1897, balance available		3,028.56
Amount (estimated) required for completion of existing project		78,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		40,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

APPROPRIATIONS.

March 3, 1879	$44,000
June 14, 1880	20,000
March 3, 1881	45,000
August 2, 1882	20,000
July 5, 1884	10,000
August 5, 1886	10,000
August 11, 1888	20,000
August 17, 1894	5,000
August 17, 1894, unexpended balance for improving St. Croix River, made available for Lubec Channel	35,000
June 3, 1896	32,000

Abstract of proposals for dredging, August 24, 1896.

No.	Name and address of bidder.	Price per cubic yard (150,000 cubic yards), measured in scow.	Amount.
1	Moore & Wright, Portland, Me.	95 cents upper shoals, 28½ cents lower portion of channel.	$53,390

Bid rejected.

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Abstract of proposals for dredging, March 31, 1897.

No.	Name and address of bidder.	Price per cubic yard dredging upper part (16,000 cubic yards), measured in scow.	Price per cubic yard dredging shoals below (134,000 cubic yards), measured in scow.	Amount.
1	Moore & Wright, Portland, Me	$1.00	$0.27	$53,180
2	Charles H. Souther, Boston, Mass	1.25	.45	80,300

Contract made with Moore & Wright, May 4 1897.

List of contracts in force during the fiscal year ending June 30, 1897.

No.	Name and address of contractor.	Date of contract.	Subject of contract.	Price per cubic yard.	Date of approval.	Beginning of work.	Expiration.
a1	Moore & Wright, Portland, Me.	Mar. 5, 1895	Dredging channel.	$0.31	Mar. 9, 1895	Aug. 1, 1895	Oct. 31, 1896
2	.....do.....	May 4, 1897	Dredging channel, upper shoals.	1.00	May 20, 1897	Aug. 1, 1897	July 1, 1898
			Dredging channel below.	.27			

a Contract completed.

COMMERCIAL STATISTICS.

Receipts and shipments.

Articles.	1896.
	Tons.
Bricks	300
Coal and wood	5,500
Fish	27,800
General merchandise	3,000
Lumber and sardine stock	12,700
Provisions	1,600
Salt	1,400
Total	52,300

Arrivals and departures in calendar year 1896.

Sailing vessels, average draft 11 feet, average tonnage 950 460

The above represents the commerce of the town of Lubec only.

The deputy collector of customs at Lubec has reported that, in addition to the foregoing, about 2,000 vessels of all classes passed through the channel or came in for refuge during 1896.

A 2.

IMPROVEMENT OF MOOSABEC BAR, MAINE.

The approved project and the report of progress of the work up to June 30, 1896, will be found in the Report of the Chief of Engineers for 1897, Part I, page 27.

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The expenditures during the fiscal year 1897 were $60.42. Operations were suspended until early in June, 1897, when the removal of ledge in the western approach to the channel was resumed under a partly completed contract. Though some work was done, no material had been actually taken up at the close of the fiscal year. About 187 cubic yards of ledge are to be removed under the contract referred to, and about 760 cubic yards more under a contract made May 22, 1897.

The improvement is in the collection district of Machias, Me., which is the nearest port of entry. The nearest light-house is Moose Peak.

Money statement.

July 1, 1896, balance unexpended		$15,091.35
June 30, 1897, amount expended during fiscal year		60.42
July 1, 1897, balance unexpended		15,030.93
July 1, 1897, outstanding liabilities	$431.03	
July 1, 1897, amount covered by uncompleted contracts	12,969.72	
		13,400.75
July 1, 1897, balance available		1,630.18
Amount (estimated) required for completion of existing project		11,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		11,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

APPROPRIATIONS.

March 3, 1881	$10,000	September 19, 1890	$15,000
August 2, 1882	10,000	July 13, 1892	15,000
July 5, 1884	10,000	August 17, 1894	6,000
August 5, 1886	10,000	June 3, 1896	12,000
August 11, 1888	15,000		

Abstract of proposals for removing ledge, March 31, 1897.

No.	Name and address of bidder.	Price per cubic yard (1,000 cubic yards) in situ.	Amount.
1	William D. Johnston, Philadelphia, Pa.	$13.75	$13,750

Contract made with William D. Johnston, May 22, 1897.

List of contracts in force during the fiscal year ending June 30, 1897.

No.	Name and address of contractor.	Date of contract.	Subject of contract.	Price per cubic yard.	Date of approval.	Beginning of work.	Expiration.
1	Townsend & Johnston, Somers Point, N. J.	Mar. 9, 1895	Removal of ledge.	$13.20	Mar. 19, 1895	May 1, 1895	June 30, 1896
2	William D. Johnston, Philadelphia, Pa.	May 22, 1897	.....do	13.75	June 7, 1897	June 1, 1897	Nov. 30, 1897

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COMMERCIAL STATISTICS.

The following letter has been received from the deputy collector of customs at Jonesport, Me.:

OFFICE OF COLLECTOR OF CUSTOMS,
Jonesport, February 10, 1897.

DEAR SIR: The benefits derived from the improvement of Mooseabec Bar are not local. This thoroughfare for ten miles, of which this bar is at the entrance, is used as a sheltered route in bad weather; also as a harbor of refuge during storms. Near as I can ascertain, there are about 2,000 vessels passing through this thoroughfare annually.

I should say there are at least:

Cargo.	Vessels.	Tonnage.	Draft.
			Feet.
Piles	200	60,000	14
Plaster	175	52,500	15
Stone	250	50,000	13
Lumber	400	60,000	12
Freight or general merchandise	200	30,000	12
Fishing (mostly in ballast)	325	.....	.....
Coal	75	22,500	12

Three hundred and seventy-five trips of passenger steamers.

Hoping this will answer for the purpose required, I remain,

Yours, very respectfully,

G. F. MANSFIELD, *Deputy Collector.*

A. N. DAMRELL,
Lieutenant-Colonel, Corps of Engineers.

A 3.

IMPROVEMENT OF NARRAGUAGUS RIVER, MAINE.

The approved project and the report of progress of the work up to June 30, 1896, will be found in the Report of the Chief of Engineers for 1897, Part I, page 28.

The expenditures during the fiscal year 1897 were but $7. No work was done until June 12, 1897, when dredging was commenced under a contract dated May 4, 1897, and at the close of the fiscal year 34,000 cubic yards of material, scow measurement, had been removed, widening the channel between the old and new steamboat wharves 50 feet, or to a width of 200 feet. The contract was completed.

The improvement is in the collection district of Machias. The nearest port of entry is Machias. The nearest light-house is Narraguagus Light-House, on Pond Island.

Money statement.

July 1, 1896, balance unexpended	$5,268.17
June 30, 1897, amount expended during fiscal year	7.00
July 1, 1897, balance unexpended	5,261.17
July 1, 1897, outstanding liabilities	4,570.00
July 1, 1897, balance available	691.17
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

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APPROPRIATIONS.

For improvement above Millbridge:	
Act of March 3, 1871	$12,000
Act of June 10, 1872	10,000
For improvement below Millbridge:	
Act of August 5, 1886	10,000
Act of August 11, 1888	10,000
Act of September 19, 1890	7,500
Act of July 13, 1892	7,500
Act of August 17, 1894	5,000
Act of June 3, 1896	5,000

Abstract of proposals for dredging, March 31, 1897.

No.	Name and address of bidder.	Price per cubic yard (40,000 cubic yards), measured in scow.	Amount.
		Cents.	
1	Moore & Wright, Portland, Me.	13	$5,200
2	Charles H. Souther, Boston, Mass.	17½	7,000

Contract made with Moore & Wright May 4, 1897.

Contract in force during the fiscal year ending June 30, 1897.

No.	Name and address of contractor.	Date of contract.	Subject of contract.	Price per cubic yard.	Date of approval.	Beginning of work.	Expiration.
				Cents.			
1	Moore & Wright, Portland, Me.	May 4, 1897	Dredging channel.	13	May 20, 1897	July 1, 1897	Sept. 30, 1897

Contract completed.

COMMERCIAL STATISTICS.

Receipts and shipments.

Articles.	1891.	1892.	1893.	1894.	1895.	1896.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Bricks	.....	.....	.....	.....	.....	65
Coal	1,200	2,000	1,500	1,000	1,300	1,100
Fish and salt	1,582	.....	400	1,500	500	630
Hides and leather	675	.....	800	1,400	5,250	.....
Hay and wood	.....	300	75	100	.....	2,500
Hardware and iron	200	1,500	2,000	2,400	1,200	180
Lumber	38,077	30,000	50,000	35,000	40,000	10,500
Miscellaneous	4,725	7,000	2,600	1,700	3,000	.....
Stone and silica	2,500	4,500	3,500	2,500	3,500	1,200
Total	48,959	45,300	60,875	95,600	54,750	16,175

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Arrivals in calendar year 1896.

Vessels.	No.	Tonnage.
Steamers drawing 12 feet	194	1,500
Sailing vessels:		
Drawing about 12 feet	4	300
Drawing about 10 feet	50	150
Drawing less than 10 feet	50	40 to 70
Drawing less than 8 feet	65	Under 40

A 4.

BREAKWATER FROM MOUNT DESERT TO PORCUPINE ISLAND, BAR HARBOR, MAINE.

The approved project and the report of progress of the work up to June 30, 1896, will be found in the report of the Chief of Engineers for 1897, Part I, page 28.

The expenditures during the fiscal year 1897 were $10,107.67, making the total expenditures $169,455.97, and completing the structure for a distance of 666 feet west of Dry Ledge. The total projected length of that portion west of the ledge is 1,440 feet.

The operations during the year consisted in extending the breakwater by the deposit of stone, under contract. Work was commenced September 12, 1896, and the contract were completed about the close of the following November. Ten thousand nine hundred and ninety-eight tons of stone was furnished and placed in the breakwater, extending it 61 feet. The price was 84½ cents per ton.

Bar Harbor is in the collection district of Frenchman Bay. The nearest port of entry is Ellsworth. The nearest light-house is on Egg Rock, 3¼ miles distant.

Money statement.

July 1, 1896, balance unexpended	$10,651.70
June 30, 1897, amount expended during fiscal year	10,107.67
July 1, 1897, balance unexpended	544.03
Amount (estimated) required for completion of existing project	250,200.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

APPROPRIATIONS.

August 11, 1888	$50,000
September 19, 1890	50,000
July 13, 1892	50,000
August 17, 1894	10,000
June 3, 1896	10,000

Abstract of proposals for placing stone in breakwater, August 24, 1896.

No.	Name and address of bidder.	Price per ton for stone (10,000 tons).	Amount.
		Cents.	
1	John L. Grim, Philadelphia, Pa	88	$8,800
2	Hamilton & Cleaves, Portland, Me	84½	8,450
3	William S. White, Rockland, Me	97	9,700

Contract made with Hamilton & Cleaves September 3, 1896.

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Contract in force during the fiscal year ending June 30, 1897.

No.	Name and address of contractor.	Date of contract.	Subject of contract.	Price per ton for stone.	Date of approval.	Beginning of work.	Expiration.
1	Hamilton & Cleaves, Portland, Me.	Sept. 3, 1896	Construction of breakwater.	*Cents.* 84½	Sept. 16, 1896	Sept. 10, 1896	Dec. 10, 1896

Contract completed.

COMMERCIAL STATISTICS.

No statement of tonnage could be obtained, but there has been no great change in the conditions.

The traffic is chiefly the transportation of passengers and supplies.

A 5.

IMPROVEMENT OF HARBOR AT SULLIVAN FALLS, MAINE.

The approved project and the report of progress of the work up to June 30, 1896, will be found in the Report of the Chief of Engineers for 1897, Part I, page 29.

There were no expenditures during the fiscal year 1897, and no work was done. A contract has been made for removing to 10 feet at mean low tide, as far as funds will permit, the ledge known as Hatchers Rock, the work to be done during the present season.

Sullivan Falls is in the collection district of Frenchman Bay. The nearest lighthouse is Crabtree Ledge Light Station.

Money statement.

July 1, 1896, balance unexpended	$5,000.00
July 1, 1897, balance unexpended	5,000.00
July 1, 1897, amount covered by uncompleted contracts	4,500.00
July 1, 1897, balance available	500.00
Amount (estimated) required for completion of existing project	30,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

APPROPRIATIONS.

Act of March 3, 1871	$10,000
Act of June 10, 1872	25,000
Act of June 3, 1896	5,000

Abstract of proposal for removing ledge, March 31, 1897.

No.	Name and address of bidder.	Price per cubic yard (300 cubic yards) situ.	Amount.
1	William D. Johnston, Philadelphia, Pa.	$16.48	$4,944

Contract made with William D. Johnston, May 22, 1897.

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Contract in force during the fiscal year ending June 30, 1897.

No.	Name and address of contractor.	Date of contract.	Subject of contract.	Price per cubic yard.	Date of approval.	Beginning of work.	Expiration.
1	William D. Johnston, Philadelphia, Pa.	May 22, 1897	Removal of ledge.	$16.48	June 7, 1897	June 1, 1897	Nov. 30, 1897

COMMERCIAL STATISTICS.

Receipts and shipments, 1896.

	Tons.
Granite and paving blocks	48,000
General mercandise	1,125
Hay	75
Lumber	2,000
Total	51,200

Arrivals in calendar year, 1896.

Sailing vessels:	
Drawing 10 feet or more	155
Drawing less than 10 feet	61
Built, tonnage 300	1

A 6.

IMPROVEMENT OF UNION RIVER, MAINE.

The approved project and the report of progress of the work to June 30, 1896, will be found in the Report of the Chief of Engineers for 1897, Part I, page 29.

There were no expenditures during the fiscal year 1897, and no work was done. Proposals for dredging have been invited, the bids to be opened July 21, 1897.

Union River is in the collection district of Frenchman Bay. The nearest lighthouse is Blue Hill Bay Light.

Money statement.

July 1, 1896, balance unexpended	$15,000.00
July 1, 1897, balance unexpended	15,000.00
Amount (estimated) required for completion of existing project	130,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

APPROPRIATIONS.

July 11, 1870	$15,000
March 3, 1871	15,000
June 3, 1896	15,000

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COMMERCIAL STATISTICS.

Receipts and shipments, 1896.

	Tons.
Coal	3,000
Fish	200
General merchandise	5,000
Hardware and iron	200
Lumber	42,600
Wood	3,000
Total	54,000

Arrivals in calendar year 1896.

Sailing vessels, average draft 10 feet, average 125 tons	200

Two steamers, average 146 tons, ply regularly between the city of Ellsworth, on the Union River, and the city of Rockland, at the western shore of Penobscot Bay.

A 7.

IMPROVEMENT OF BAGADUCE RIVER, MAINE.

The approved project and the report of progress of the work to June 30, 1896, will be found in the Report of the Chief of Engineers for 1897, Part I, page 30.

The expenditures during the fiscal year 1897 were $29.50 No work was done. Proposals for continuing the excavation of the channel with the available funds have been invited, the bids to be opened July 21, 1897.

The improvement is in the collection district of Castine. The nearest port of entry is Castine, at the mouth of the river. The nearest light-house is at Dice Head.

Money statement.

July 1, 1896, balance unexpended	$5,004.66
June 30, 1897, amount expended during fiscal year	29.50
July 1, 1897, balance unexpended	4,975.16
July 1, 1897, outstanding liabilities	25.00
July 1, 1897, balance available	4,950.16
Amount (estimated) required for completion of existing project	24,875.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	24,875.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

APPROPRIATIONS.

August 11, 1888	$3,000
September 19, 1890	4,000
July 13, 1892	5,000
August 17, 1894	5,000
June 3, 1896	5,000

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COMMERCIAL STATISTICS.

Receipts and shipments.

Articles.	1891.	1892.	1893.	1894.	1895.	1896.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Bricks	6,000	7,500	8,000	8,000	8,000	7,000
Coal	2,200	2,350	2,300	2,500	3,500	2,500
Cotton	150	150	200	200	300	300
Farm produce	250	300	400	400	400	350
Fish	150	300	250	300	300	300
Grain	8,000	9,000	9,000	9,500	10,000	10,000
General merchandise	15,300	17,000	18,000	20,000	20,000	20,000
Granite				5,000	5,000	5,000
Ice	150	200	250	350	400	400
Iron pipe				100		
Lumber and cooperage	2,800	3,500	5,000	15,000	18,000	15,000
Lime, cement, etc	300	400	400	1,000	15,000	12,200
Wood	6,000	5,400	5,500	5,500	6,000	5,000
Total	41,300	46,100	49,300	67,850	85,900	78,050

Arrivals in calendar year 1896.

Steamers:	
Drawing 10 feet or more, 500 to 1,500 tons	200
Drawing less than 10 feet, 5 to 250 tons	500
Sailing vessels:	
Drawing 10 feet or more, 150 to 400 tons	90
Drawing less than 10 feet, 5 to 50 tons	250
Vessels built	6
Steamboat line established	1

Most of the above is landed and shipped from Castine, at the mouth of the river.

A 8.

IMPROVEMENT OF PENOBSCOT RIVER, MAINE.

The approved project and the report of progress of the work to June 30, 1896, will be found in the Report of the Chief of Engineers for 1897, Part I, page 30.

The expenditures during the fiscal year 1897 were $330.74. No work was done, the only operations consisting of an examination of work previously done, made late in 1896. It was found that at Frankfort Flats there was a good channel not less than 300 feet wide, with a depth of not less than 22 feet at mean low tide. At High Head there was a break in the 22-foot contour for a distance of 500 feet. On the crest of this shoal the least depth was in excess of 19 feet at mean low tide.

No appropriation is asked for further work under the proposed present project, but an extension of the project is in the report of a recent survey in the vicinity of Bangor, Me. (House Ex. Doc. No. 49, Fifty-first Congress, first session.)

Money statement.

July 1, 1896, balance unexpended	*$10,363.88
June 30, 1897, amount expended during fiscal year	330.74
July 1, 1897, balance unexpended	10,033.14
Amount (estimated) required for completion of existing project	290,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

* Differs from last year's report by 59 cents, being amount of Treasury settlement for telegrams made in May, 1896.

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APPROPRIATIONS.

March 2, 1829 (for survey)	$300
July 11, 1870 (at Bangor and below)	15,000
March 3, 1871 (at Bangor and below)	50,000
June 10, 1872	40,000
March 3, 1873	20,000
June 23, 1874	20,000
March 3, 1875 ($10,000 to be expended at or near Bucksport Narrows)	25,000
August 14, 1876 ($4,000 to be expended at or near Bucksport Narrows)	10,000
June 18, 1878 ($2,500, or so much thereof as necessary, to be expended at or near Bucksport Narrows)	12,000
March 3, 1879	6,000
July 5, 1884 (for Bangor Harbor and Penobscot River)	20,000
August 5, 1886 (for widening channel at Bangor and removing obstructions near Crosbys Narrows)	15,000
August 11, 1888 ($20,000 to be expended between Bangor and Crosbys Narrows and $30,000 between Bucksport and Winterport)	50,000
September 19, 1890 (for continuing improvement and for dredging near Sterns's mill)	25,000
July 13, 1892	40,000

COMMERCIAL STATISTICS.

Receipts and shipments.

Articles.	1891.	1892.	1893.	1894.	1895.	1896.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Ashes	500	500	575	438	265	.....
Bricks	8,575	3,266	2,840	1,940	1,963	1,254
Brimstone	.....	500	535	2,178	1,219	1,487
Coal	104,113	115,000	120,000	120,091	199,649	212,513
Farm produce	2,025	2,000	2,300	2,162	2,100	2,730
Fish and oysters	107	200	240	200	160	525
Flour, grain, and feed	11,865	6,325	6,840	13,646	22,312	23,142
Fertilizer and plaster rock	1,400	2,000	2,140	4,750	5,766	4,080
General merchandise	51,333	52,209	53,420	51,820	28,463	24,831
Hay and wood	72,220	12,647	13,000	10,200	7,969	7,950
Iron, castings, etc	505	840	12,600	1,210	2,665	3,754
Ice	270,000	181,000	90,000	193,789	86,000	161,000
Lime and cement	568	4,350	4,400	2,615	5,680	4,634
Lumber	320,000	294,603	223,332	315,200	224,092	187,609
Last blocks	.....	400	400	325	200	.....
Molding sand and potters' clay	.....	1,000	1,200	820	1,059	3,727
Miscellaneous	53,728	.....	700	1,154	2,874	1,300
Molasses and salt	1,841	2,701	1,771	1,945	2,386	2,762
Oil	2,500	3,094	3,594	5,070	5,838	7,254
Paving stone, granite, and slate	30,500	32,300	26,000	20,765	17,199	44,635
Spool wood and shooks	.....	.....	.....	.....	.....	20,725
	931,780	714,935	565,887	750,313	617,859	715,911

Arrivals and departures in calendar year 1896.

Steamers:	
Coastwise, drawing 5 to 14 feet, average 800 tons	656
Foreign, drawing 10 to 20 feet, average 1,000 tons	10
Sailing vessels:	
Coastwise, drawing 5 to 22 feet, average 300 tons	2,682
Foreign, drawing 8 to 20 feet, average 600 tons	56
Built, 8½ tons	1
Total	3,405

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A 9.

IMPROVEMENT OF BELFAST HARBOR, MAINE.

The approved project and the report of progress of the work to June 30, 1896, will be found in the Report of the Chief of Engineers for 1897, Part I, page 32.

The expenditures during the fiscal year 1897 were $1,616.07. No work was done until May 22, 1897, when dredging was commenced under a contract dated September 4, 1896. By the close of the fiscal year 50,506 cubic yards of material had been removed from the area on the south side of the channel, in front of the Boston steamboat wharf, completing the contract and also the project.

Belfast is in the collection district of Belfast. The nearest light-house is Dice Head, near Castine.

Money statement.

July 1,1896, balance unexpended	$8,285.18
June 30, 1897, amount expended during fiscal year	1,616.07
July 1, 1897, balance unexpended	6,669.11
July 1, 1897, outstanding liabilities	6,030.56
July 1, 1897, balance available	638.55

APPROPRIATIONS.

August 14, 1876	$5,000	September 19, 1890	$10,000
June 18, 1878	12,000	July 13, 1892	10,000
March 3, 1879	5,000	August 17, 1894	8,000
June 14, 1880	3,000	June 3, 1896	8,000

Abstract of proposals for dredging, August 24, 1896.

No.	Name and address of bidder.	Price per cubic yard, measured in scow (52,000 cubic yards).	Amount.
		Cents.	
1	Moore & Wright, Portland, Me	14½	$7,410
2	Hamilton & Sawyer, Cheabeague, Me	13⅞	7,215

Contract made with Hamilton & Sawyer September 4, 1896.

Contract in force during the fiscal year ending June 30, 1897.

No.	Name and address of contractor.	Date of contract.	Subject of contract.	Price per cubic yard.	Date of approval.	Beginning of work.	Expiration.
				Cents.			
1	Hamilton & Sawyer, Cheabeague, Me.	Sept. 4, 1896	Dredging.	13⅞	Sept. 17, 1896	May 1, 1897	June 30, 1897

Completed.

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COMMERCIAL STATISTICS.

Receipts and shipments.

Articles.	1891.	1892.	1893.	1894.	1895.	1896.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Coal	10,710	10,800	10,900	11,220	14,000	14 500
Farm produce	910	915	820	840	840	710
Fertilizers	1,500	3,000	3,000	4,000	4,000	4,400
Grain	5,029	5,000	5,300	4,500	5,000	5,500
General merchandise	20 112	21,200	20,200	24,500	21,200	24,100
Hay	7 127	7,450	3,600	7,500	6,500	6,300
Ice	13,000	8,000	5,000	4,800	2,500	2,000
Lumber	3,400	2,900	2,500	3,300	3,500	3,300
Lime	1,325	1,410	1,200	.....	800	700
Stone	7,000	6,000	5,200	.....	.....	.....
Wood	980	850	750	910	840	730
Total	71,093	67,525	58,470	61,580	59,180	62,240

A 10.

IMPROVEMENT OF HARBOR AT CAMDEN, MAINE.

The approved project and the report of progress of the work to June 30, 1896, will be found in the Report of the Chief of Engineers for 1897, Part 1, page 32.

The expenditures during the fiscal year 1897 were $10,048.17. Dredging was commenced September 21, 1896, under a contract dated September 4, 1896, and the contract was completed on the 3d of the following December, when 61,999 cubic yards of material had been removed. The removal of the middle ground was practically finished, and the project was completed.

Camden is in the collection district of Belfast. The nearest light-house is on Negro Island, at entrance of harbor.

Money statement.

July 1, 1896, balance unexpended	$10,361.22
June 30, 1897, amount expended during fiscal year	10,048.17
July 1, 1897, balance unexpended	313.05

APPROPRIATIONS.

March 3, 1873	$10,000	September 19, 1890	$6,000
June 23, 1874	10,000	July 13, 1892	12,000
March 3, 1875	10,000	August 17, 1894	12,000
August 11, 1888	5,000	June 3, 1896	10,000

Abstract of proposals for dredging, August 24, 1896.

No.	Name and address of bidder.	Price per cubic yard, measured in scow (60,000 cubic yards).	Amount.
		Cents.	
1	Moore & Wright, Portland, Me	16½	$9,900
2	Hamilton & Sawyer, Cheabeague, Me	14¼	8,850
3	Simon J. Donovan, Winthrop, Mass	17	10,200

Contract made with Hamilton & Sawyer September 4, 1896.

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Contract in force during the fiscal year ending June 30, 1897.

No.	Name and address of contractor.	Date of contract.	Subject of contract.	Price per cubic yard.	Date of approval.	Beginning of work.	Expiration.
				Cents.			
1	Hamilton & Sawyer, Cheabeague, Me.	Sept. 4, 1896	Dredging channel.	14¾	Sept. 17, 1896	Oct. 1, 1896	Apr. 30, 1897

Completed.

COMMERCIAL STATISTICS.

It has been impracticable to obtain statistics.

A 11.

IMPROVEMENT OF HARBOR AT ROCKLAND, MAINE.

The approved project and the report of progress of the work to June 30, 1896, will be found in the Report of the Chief of Engineers for 1897, Part I, page 33.

The expenditures during the fiscal year 1897 were $872.38.

A contract was made May 4, 1897, for completing the breakwater, the price being 59.3 cents per ton (2,000 pounds) of stone furnished and placed in the work. The contractor began delivering stone June 3, 1897, and at the close of the fiscal year had deposited 2,260 tons in place.

Rockland is in the collection district of Waldoboro. There is a light on the end of the breakwater.

Money statement.

July 1, 1896, balance unexpended		$25,871.90
Amount appropriated by sundry civil act approved June 4, 1897		350,000.00
		375,871.90
June 30, 1897, amount expended during fiscal year		872.38
July 1, 1897, balance unexpended		374,999.52
July 1, 1897, outstanding liabilities	$330.00	
July 1, 1897, amount covered by uncompleted contracts	207,550.00	
		207,880.00
July 1, 1897, balance available		167,119.52
Amount (estimated) required for completion of existing project		410,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		410,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

APPROPRIATIONS.

June 14, 1880	$20,000	September 19, 1890	$37,500
August 2, 1882	40,000	July 13, 1892	30,000
July 5, 1884	40,000	August 17, 1894	30,000
August 5, 1886	22,500	June 3, 1896	25,500
August 11, 1888	30,000	June 4, 1897	350,000

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Abstract of proposals for constructing breakwater, March 8, 1897.

No.	Name and address of bidder.	Price per ton for stone (350,000 tons).	Amount.
		Cents.	
1	Hamilton & Cleaves, Portland, Me.	75	$262,500
2	Charles H. Souther, Boston, Mass.	59.3	207,550
3	William S. White, Rockland, Me.	71½	250,250
4	T. W. Kinser & Sons, Terre Haute, Ind.	68	238,000

Contract made with Charles H. Souther May 4, 1897.

Contract in force during the fiscal year ending June 30, 1897.

No.	Name and address of contractor.	Date of contract.	Subject of contract.	Price per ton for stone.	Date of approval.	Beginning of work.	Expiration.
				Cents.			
1	Charles H. Souther, Boston, Mass.	May 4, 1897	Constructing breakwater.	59.3	May 24, 1897	June 1, 1897	June 30, 1898

COMMERCIAL STATISTICS.

Receipts and shipments.

Articles.	1891.	1892.	1893.	1894.	1895.	1896.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Brick, cement, and sand	3,897	42,904	36,614	89,275	38,250	37,950
Coal	33,505	42,480	51,000	63,000	55,780	55,350
Fish and salt, etc.	2,569	8,257	9,908	9,578	.....	10,540
Grain and flour	6,147	9,620	10,822	11,749	10,500	13,140
General merchandise	67,579	28,100	64,035	71,138	72,490	70,850
Hay and straw	.....	413	500	500	575	540
Ice	4,672	.....	2,000	4,320	3,200	4,500
Lumber and ship timbers	24,376	27,680	29,190	28,742	27,250	28,950
Lime	160,000	97,785	130,000	116,000	156,000	127,500
Oil	.....	538	605	663	1,400	700
Stone	54,778	74,397	7,605	9,926	8,525	8,000
Sawdust and ashes	.....	6,071	5,404	5,642	4,985	4,800
Steel rails, ironwork, and castings	.....	2,172	2,323	1,963	1,250	2,225
Wood and cooperage	76,237	188,388	188,500	147,357	235,625	215,250
Total	433,760	528,805	538,506	509,853	615,830	580,295

Number of vessels arriving in calendar year 1896.

Steamers:	
Coastwise, 400 to 1,500 tons each	635
Coastwise, 25 to 400 tons each	2,250
Coastwise, under 25 tons each	280
Sailing vessels:	
Foreign, average 90 tons each	400
Coastwise (tonnage not stated)	4,225
For refuge only	1,150

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A 12.

IMPROVEMENT OF CARVERS HARBOR, VINALHAVEN, MAINE.

The approved project and the report of progress of the work to June 30, 1896, will be found in the Report of the Chief of Engineers for 1897, Part I, page 34.

There were no expenditures during the fiscal year 1897, and no work was done. Proposals for beginning the dredging of the harbor have been invited, the bids to be opened July 21, 1897.

Carvers Harbor is in the collection district of Belfast. The nearest light-house is Heron Neck.

Money statement.

July 1, 1896, balance unexpended	$10,000.00
July 1, 1897, balance unexpended	10,000.00
Amount (estimated) required for completion of existing project	54,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	54,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

APPROPRIATION.

June 3, 1896	$10,000

COMMERCIAL STATISTICS.

Receipts and shipments, 1896.

	Tons.
Coal, hay, wood, lumber, and general merchandise, etc	9,589
Lobsters	500
Fish, salt, ice, bait, etc	4,000
Stone	48,989
Total	63,078

Arrivals in calendar year 1896.

Sailing vessels:	
Draft 9 to 18 feet, 75 to 400 tons	179
Draft 6 to 12 feet, 15 to 200 tons	128
Draft 5 to 14 feet, 7 to 75 tons	313
Boats making about 6,000 trips in a year, draft 4 to 8 feet, 5 to 12 tons	100
Steamers making 3 trips daily	2
Steamers and vessels arriving for refuge	500

A 13.

IMPROVEMENT OF GEORGES RIVER, MAINE.

The approved project and the report of progress of the work to June 30, 1896, will be found in the Report of the Chief of Engineers for 1897, Part I, page 35.

There were no expenditures during the fiscal year 1897, and no work was done. A contract has been made for dredging to the extent of the available funds, the work to be done during the present season.

Georges River is in the collection district of Waldoboro. The nearest light-house is Franklin Island.

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Money statement.

July 1, 1896, balance unexpended	$10,000.00
July 1, 1897, balance unexpended	10,000.00
July 1, 1897, amount covered by uncompleted contracts	9,000.00
July 1, 1897, balance available	1,000.00
Amount (estimated) required for completion of existing project	20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

APPROPRIATION.

Act of June 3, 1896 ..... $10,000

Abstract of proposals for dredging, March 31, 1897.

No.	Name and address of bidder.	Price per cubic yard (50,000 cubic yards), measured in scow.	Amount.
		Cents.	
1	Moore & Wright, Portland, Me.	18	$9,000
2	Augustus B. Martin, Boston, Mass.	19	9,500
3	Hamilton & Sawyer, Cheabeague, Me.	14 7/10	7,350
4	Charles H. Souther, Boston, Mass.	20	10,000

Contract made with Hamilton & Sawyer May 8, 1897.

Contract in force during the fiscal year ending June 30, 1897.

No.	Name and address of contractor.	Date of contract.	Subject of contract.	Price per cubic yard.	Date of approval.	Beginning of work.	Expiration.
				Cents.			
1	Hamilton & Sawyer, Portland, Me.	May 8, 1897	Dredging channel.	14 7/10	May 20, 1897	July 20, 1897	Oct. 20, 1897

COMMERCIAL STATISTICS.

Receipts and shipments, 1896.

	Tons.
Coal	6,000
Cement and general merchandise	2,000
Lime	19,000
Lumber and ship timbers	9,875
Wood	8,500
Total	45,375

Arrivals in calendar year 1896.

Sailing vessels, coastwise, 75 to 300 tons	300
Steam tug	1
Vessel built, about 900 tons	1

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A 14.

IMPROVEMENT OF KENNEBEC RIVER, MAINE.

The approved project and the report of progress of the work to June 30, 1896, will be found in the Report of the Chief of Engineers for 1897, Part I, page 35.

The expenditures during the fiscal year 1897 were $27,656.31.

The redredging of the channels west of Swan Island, which was in progress under open-market agreement at the close of the last fiscal year, was completed July 22, 1896.

The total quantity of material moved was 35,670 cubic yards, scow measurement, giving channels 11 feet deep at mean low tide through the three shoals west of the island. Work was then resumed at Britts Shoal, under contract, and continued until the last of September, when the contract was completed. The total quantity removed under this contract, including the operations of the previous fiscal year, was 133,715 cubic yards. A depth of 10 feet at mean low tide can now be carried to within about one-half mile of Augusta, the head of navigation.

The work of ledge excavation at Lovejoy Narrows, under contract with Rogers & Fitzpatrick, which was in progress at the close of the fiscal year 1896, was continued until November 3, 1896, when 1,383.26 cubic yards had been removed, completing the contract. This finished all the work proposed at that locality.

Unless new conditions develop, only the dredging at Gages Shoal, near Augusta, is to be done in order to complete the project. Bids for the latter work were received March 31, 1897, but, the proposals containing provisions at variance with the specifications, all bids were rejected. The work has been readvertised, the bids to be opened July 21, 1897.

No further appropriation is asked for the present.

The improvement is in the collection district of Bath, of which Bath is the port of entry. Fort Popham and the light-house on Pond Island are near the mouth of the river.

Money statement.

July 1, 1896, balance unexpended	$79,902.90
June 30, 1897, amount expended during fiscal year	27,656.31
July 1, 1897, balance unexpended	52,246.59
July 1, 1897, outstanding liabilities	200.00
July 1, 1897, balance available	52,046.59
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	58,500.00

APPROPRIATIONS.

March 2, 1827	$4,000	March 3, 1873	$12,000
March 19, 1828	3,500	June 23, 1874	12,000
April 23, 1830	5,000	March 3, 1875	15,000
August 30, 1852	6,000	March 3, 1881	10,000
June 23, 1866	20,000	August 11, 1888	75,000
March 2, 1867	30,000	September 19, 1890	50,000
April 10, 1869	14,850	July 13, 1892	100,000
July 11, 1870	15,000	August 17, 1894	50,000
March 3, 1871	15,000	June 3, 1896	55,000
June 10, 1872	8,000		

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Abstract of proposals for dredging, March 31, 1897.

No.	Name and address of bidder.	45,000 cubic yards (price for Gages Shoal, per cubic yard, measured in scow).	Price for redredging, measured in scow.	Amount.
		Cents.	*Cents.*	
1	Moore & Wright, Portland, Me	40	40	$18,000
2	Augustus B. Martin, Boston, Mass	48	49½	21,600
3	Charles H. Souther, Boston, Mass	55	59	24,750

All bids rejected.

List of contracts in force during the fiscal year ending June 30, 1897.

No.	Name and address of contractor.	Date of contract.	Subject of contract.	Price per cubic yard.	Date of approval.	Beginning of work.	Expiration.
1*a*	Rogers & Fitzpatrick, Plattsburg, N. Y.	Mar. 27, 1895	Removal of ledge at Lovejoy Narrows.	$9.87	Apr. 8, 1895	May 1, 1895	Nov. 1, 1896
2*a*	Moore & Wright, Portland, Me.	Apr. 1, 1895	Dredging at Beef Rock Shoal.	.24	Apr. 8, 1895	May 1, 1895	June 30, 1897
			At Shepards Point, Hallowell, and Britts shoals.	.29			

a Contract completed.

COMMERCIAL STATISTICS.

Receipts and shipments.

Articles.	1891.	1892.	1893.	1894.	1895.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Bricks	1,903	13,500	400	7,150	950
Coal	123,356	150,000	162,075	130,079	168,429
Cement and plaster	335	532	415	475	590
Grain	150	195	50	200	500
General merchandise	22,400	33,000	42,801	2,800	41,870
Granite and feldspar	12,000	12,000	7,550	16,150	6,200
Hay	13,255	16,150	2,750	2,987	3,460
Ice	846,165	925,000	657,700	1,007,000	872,000
Iron	830	465	2,360	1,650	1,650
Lime and fertilizer	245	.....	325	1,325	395
Lumber and ship timbers	186,523	111,953	91,286	35,433	64,060
Salt	2,212	.....	726	.....	738
Wood	1,100	.....	2,500	2,716	2,130
Total	1,210,474	1,263,145	970,938	1,207,965	1,162,972

Commercial statistics for the year 1896 could not be obtained.

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A 15.

IMPROVEMENT OF SASANOA RIVER, MAINE.

The approved project and the report of progress of the work to June 30, 1896, will be found in the Report of the Chief of Engineers for 1897, Part I, page 37.

The expenditures during the fiscal year 1897 were $439.07.

The removal of ledge at Hell Gate was commenced during the latter part of May, 1897, under contract made May 3, 1897. At the close of the fiscal year about 113 cubic yards of ledge had been taken out. The contract covers the removal of about 800 cubic yards.

The improvement is in the collection district of Bath. The nearest light-house is on Hendricks Head.

Money statement.

July 1, 1896, balance unexpended		$19,000.00
June 30, 1897, amount expended during fiscal year		439.07
July 1, 1897, balance unexpended		18,560.93
July 1, 1897, outstanding liabilities	$174.10	
July 1, 1897, amount covered by uncompleted contracts	9,190.96	
		9,365.06
July 1, 1897, balance available		9,195.87

APPROPRIATIONS.

July 11, 1870	$10,000	June 14, 1880	$7,000
March 3, 1871	6,500	March 3, 1881	5,000
June 18, 1878	17,000	June 3, 1896	19,000

Abstract of proposals, March 31, 1897.

No.	Name and address of bidder.	Price per cubic yard for ledge (900 cubic yards) situ.	Price per cubic yard for dredging (2,000 cubic yards) measured in scow.	Amount.
1	Robert H. Rogers, Plattsburg, N. Y.	$10.48	.....	$9,432
2	William D. Johnston, Philadelphia, Pa.	12.75	.....	11,475
3	Moore & Wright, Portland, Me.	.....	$0.25	500

Contract made with Robert H. Rogers, May 3, 1897. Bid for dredging rejected.

Contract in force during the fiscal year ending June 30, 1897.

No.	Name and address of contractor.	Date of contract.	Subject of contract.	Price per cubic yard.	Date of approval.	Beginning of work.	Expiration.
1	Robert H. Rogers, Plattsburg, N. Y.	May 3, 1897	Removing ledge.	$10.48	May 20, 1897	May 1, 1897	Nov. 15, 1897

COMMERCIAL STATISTICS.

It has not been practicable to obtain commercial statistics.

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A 16.

IMPROVEMENT OF PORTLAND HARBOR, MAINE.

The approved project and the report of progress of the work to June 30, 1896, will be found in the Report of the Chief of Engineers for 1897, Part I, page 37.

The expenditures during the fiscal year 1897 were $1,731.37. There was no work of improvement done during the year. June 4, 1897, a contract was entered into for doing all the work covered by the present project. At the close of the year the contractors had placed a dredge and two scows on the work, but no dredging had yet been done.

The harbor is defended by Forts Preble, Gorges, Scammel, and a battery at Portland Head. There is a light-house on the breakwater and one at Portland Head, 3 miles distant from the city. The harbor is in the collection district of Portland and Falmouth, of which Portland is the port of entry.

Money statement.

July 1, 1896, balance unexpended	*$20,291.80
Amount appropriated by sundry civil act approved June 4, 1897	350,000.00
	370,291.80
June 30, 1897, amount expended during fiscal year	1,731.37
July 1, 1897, balance unexpended	†368,560.43
July 1, 1897, outstanding liabilities	400.00
July 1, 1897, amount covered by uncompleted contracts	†518,499.00
Amount (estimated) required for completion of existing project	460,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	460,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

APPROPRIATIONS.

July 4, 1836, for breakwater	$10,000.00
March 3, 1837, for breakwater	25,000.00
July 7, 1838, for breakwater	26,366.00
June 23, 1866, for extending breakwater, but unexpended balance made available for excavating middle ground by joint resolution of June 5, 1868	105,111.05
July 11, 1870, for improving harbor	10,000.00
March 3, 1871, for improving harbor	40,000.00
June 10, 1872, for improving Portland Harbor and Back Bay	45,000.00
March 3, 1873, for improving harbor	50,000.00
June 23, 1874, for improving harbor	20,000.00
March 3, 1875, for improving harbor	20,000.00
March 3, 1881, for improving harbor	20,000.00
August 2, 1882, for improving harbor	35,000.00
July 5, 1884, for improving harbor	30,000.00
August 5, 1886, for improving harbor	30,000.00
August 5, 1886, for Back Cove	26,250.00
August 11, 1888, for improving harbor	40,000.00
August 11, 1888, for Back Cove	25,000.00
September 19, 1890, for improving harbor	40,000.00
September 19, 1890, for Back Cove	25,000.00
July 13, 1892, for improving harbor	30,000.00
July 13, 1892, for Back Cove	20,000.00
August 17, 1894, for Back Cove	20,000.00
June 3, 1896	20,000.00
January 4, 1897	350,000.00

*Includes $291.80 from account for Back Cove.

† This work is carried on under a continuous contract.

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Abstract of proposals for dredging, January 14, 1897.

No.	Name and address of bidder.	Back Cove.		Portland Harbor.		
		125,000 cubic yards. (Price per cubic yard situ.)	Amount.	Plan A, 800,000 cubic yards. (Price per cubic yard situ.)	Plan B, 4,975,000 cubic yards. (Price per cubic yard situ.)	Amount.
1	John B. Breyman and Eugene Breyman, Toledo, Ohio	*Cents.* 20	$25,000.00	*Cents.*	*Cents.* 20	$995,000.00
2	Alabama Dredging and Jetty Co., Mobile, Ala	20	25,000.00	17	.....	136,000.00
		.....	.....	.....	15	746,250.00
3	M. J. Fenton & Co., New York, N. Y.	16⅔	20,833.33	16⅔	.....	133,333.33
		.....	.....	.....	12½	621,875.00
4	Charles H. Souther and Augustus B. Martin, Boston, Mass	27½	34,375.00	33	.....	264,000.00
		.....	.....	.....	15½	771,125.00
5	American Dredging Co., Philadelphia, Pa	27	33,750.00	.....	16	796,000.00
6	Moore & Wright, Portland, Me	24⅞	30,937.50	25 1/10	.....	204,800.00
		.....	.....	.....	14⅞	740,031.00
7	Morris & Cummings Dredging Co., New York, N. Y.	30	37,500.00	.....	16	796,000.00

All bids rejected.

Abstract of proposals for dredging, April 29, 1897.

No.	Name and address of bidder.	1.		2.			
		Plan A, and Back Cove 830,000 cubic yards.	29-foot area 95,000 cubic yards.	Amount.	Plan B and Back Cove 5,005,000 yards.	29-foot area 95,000 cubic yards.	Amount.
1	Morris & Cummings Dredging Co., New York, N. Y.	*Cents.* 23.5	*Cents.* 37	$230,200	*Cents.* 15	*Cents.* 37	$785,900
2	Moore & Wright, Portland, Me.	22.5	32	217,150	14.3	32	746,115
3	Rittenhouse Moore Dredging Co., Mobile, Ala	23.5	34.5	227,825	14.7	34.5	786,510
4	Baltimore Dredging Co., Baltimore, Md.	24.7	39.4	242,440	15.2	39.3	798,095
5	American Dredging Co., Philadelphia, Pa.	24.5	40	241,350	15.5	40	813,795
6	Geo. M. Valentine & Co., New York, N. Y.	14.4	20	138,520	9.98	20	518,499

Contract made with George M. Valentine & Co., June 4, 1897.

Contract in force during the fiscal year ending June 30, 1897.

No.	Name and address of contractor.	Date of contract.	Subject of contract.	Price per cubic yard.	Date of approval.	Beginning of work.	Expiration.
1	Geo. M. Valentine & Co., New York, N. Y.	June 4, 1897	Dredging	*Cents.* a 29.98 b 20	June 22, 1897	June 1, 1897	Fixed by rate of progress prescribed in the contract.

a Under plan B and Back Cove. *b* For 29-foot area.

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COMMERCIAL STATISTICS.

Receipts and shipments.

Articles.	1891.	1892.	1893.	1894.	1895.	1896.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Apples and citrous fruits	107,801	5,733	2,662	7,052	14,022	21,522
Bacon, flour, and provisions	810	18,700	18,640	19,566	31,401	55,999
Bricks, stone, molding sand and clay	21,378	29,805	30,719	38,181	25,601	31,866
Coal and wood	600,000	600,000	621,930	517,152	544,009	542,055
Cattle on hoof	3,185	3,512	733	5,466	4,443	4,391
Cotton, sisal, and rags	2,874	3,815	5,000	2,175	4,283	128
Cement, lime, and pipe	14,915	17,165	6,001	4,036	7,279	20,298
Cooperage, lumber, and railroad ties	41,507	71,527	79,808	64,594	61,015	76,471
Fish and salt	13,416	14,166	56,795	56,805	91,796	99,015
General merchandise and dry goods	502,626	450,644	318,699	298,320	347,501	303,663
Grain, feed, and hay	29,936	91,970	111,181	89,702	58,838	67,364
Ice	6,154	26,637	1,000	40,000	35,000	18,000
Iron, lead, machinery, and tin	2,773	7,550	37,462	11,481	17,149	14,067
Molasses and sugar	.....	8,360	2,782	4,111	17,589	17,968
Oils, paints, and asbestos	20,862	26,531	36,000	26,000	27,500	25,000
Printing paper, china clay, brimstone, and whiting	.....	600	103,443	30,296	51,688	59,558
Total	1,368,237	1,376,815	1,432,805	1,214,887	1,339,064	1,357,575

Arrivals in calendar year 1896.

Steamers:	
Coastwise, drawing 12 to 18 feet, average 1,000 tons	637
Coastwise, drawing 9½ feet, average 150 tons	1,098
Coastwise, drawing 8½ feet, average 210 tons	200
Foreign, drawing 25 feet, average 4,339 tons	33
Foreign, drawing 18 to 25 feet, average 3,000 tons	9
For refuge	50
Sailing vessels:	
Foreign, average 150 tons	83
Foreign, average 100 tons	62
Coastwise, drawing 10 feet or more, average 800 tons	2,000
Coastwise, drawing 10 feet or less, average 150 tons	1,500
For refuge	1,200
Coastwise, average draft 18 feet, over 1,000 tons each	5
Coastwise, average draft 16 feet, over 1,000 tons each	74

A 17.

IMPROVEMENT OF SACO RIVER, MAINE.

The approved project and the report of progress of the work to June 30, 1896, will be found in the Report of the Chief of Engineers for 1897, Part I, page 39.

The expenditures during the fiscal year 1897 were $317.33. No work was done during the year.

An examination at the mouth of the river, made in December, 1896, showed that the 6-foot channel had developed and maintained under the combined influence of the breakwater and jetty, and all that remains to be done to complete the project is to raise the shore end of the breakwater and extend it far enough inshore to prevent sand from being carried over and around it during northeasterly storms. Proposals for doing this work are to be opened July 21, 1897.

No further appropriation is asked for the present.

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Saco River is in the collection district of Saco, Me., of which Saco is the port of entry. The nearest light-house is on Wood Island.

Money statement.

July 1, 1896, balance unexpended	$10,693.88
June 30, 1897, amount expended during fiscal year	317.33
July 1, 1897, balance unexpended	10,376.55
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	52,500.00

APPROPRIATIONS.

March 2, 1827, for piers, buoys, and removing obstructions at and near entrance	$7,000
June 23, 1866, for repairing piers	40,000
March 2, 1867, for improving river	40,000
July 25, 1868, for improving river	20,000
April 10, 1869, for improving river	22,275
July 11, 1870, for improving river	10,000
March 3, 1871, for improving river	15,000
June 10, 1872, for improving river	15,000
July 5, 1884, for breakwater	15,000
August 5, 1886, for breakwater	12,500
August 5, 1886, for improving river	12,500
August 11, 1888, for breakwater	12,500
August 11, 1888, for improving river	10,000
September 19, 1890, for improving river, including breakwater and jetty	65,000
July 13, 1892, for improving river, including breakwater	25,000
August 17, 1894, for improving river, including breakwater	10,000
June 3, 1896, for improving river, including breakwater	10,000

COMMERCIAL STATISTICS.

Receipts and shipments.

Articles.	1891.	1892.	1893.	1894.	1895.	1896.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Bricks	6,000	6,100	9,700	9,840	8,356	9,160
Coal	40,724	39,266	48,962	35,780	44,554	35,995
Cement and lime	485	360	249	1,056	210	420
Iron	1,684	972	453	236	1,196	744
Lumber	80	120	.....	67	.....	.....
Molding sand	480	250	272	278	653	477
Powder, ashes, and phosphate	92	.....	28	.....	.....	.....
Roofing gravel	220	40	101	93	160	160
Stone (granite)	.....	.....	.....	.....	7,000	.....
Total	49,765	47,108	59,765	47,350	62,129	46,956

Number of arrivals in calendar year 1896.

Sailing vessels, coastwise, drawing 8 to 12½ feet	155

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A 18.

IMPROVEMENT OF BELLAMY RIVER, NEW HAMPSHIRE.

The approved project and the report of progress of the work to June 30, 1896, will be found in the Report of the Chief of Engineers for 1897, Part I, page 40.

The expenditures during the fiscal year 1897 were $5,378.97. The operations consisted in completing the dredging of the channel and turning basin under a contract in progress at the close of the previous fiscal year. The contract was completed September 18, 1896, the total quantity of material excavated thereunder being 58,810 cubic yards. This completed the project.

Money statement.

July 1, 1896, balance unexpended	$5,735.99
June 30, 1897, amount expended during fiscal year	5,378.97
July 1, 1897, balance unexpended	357.02

APPROPRIATIONS.

August 11, 1888	$10,000	July 13, 1892	$7,500
September 19, 1890	10,000	August 17, 1894	7,500

Contract in force during fiscal year ending June 30, 1897.

No.	Name and address of contractor.	Date of contract.	Subject of contract.	Price per cubic yard.	Date of approval.	Beginning of work.	Expiration.
1	Columbian Dredging Co., East Boston, Mass.	Apr. 26, 1895	Dredging channel.	*Cents.* 23	May 11, 1895	Aug. 1, 1895	Dec. 31, 1896

Contract completed.

COMMERCIAL STATISTICS.

Statistics for 1896 could not be obtained.

A 19.

IMPROVEMENT OF COCHECO RIVER, NEW HAMPSHIRE.

The approved project and the report of progress of the work to June 30, 1896, will be found in the Report of the Chief of Engineers for 1897, Part I, page 40.

The expenditures during the fiscal year 1897 were $8,137.67.

The operations consisted in completing the excavation of the channel through the Upper Narrows and the removal of a small shoal at Dover, formed during the freshet of March, 1896. Under contract with Andrew W. Bryne, which was in progress at the close of the fiscal year 1896, the work of ledge excavation at Upper Narrows was continued until November 21, 1896, when the contract was completed, and the channel at that locality practically so. The total quantity of ledge removed was 2,388 cubic yards, measured in place.

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The shoal at Dover, which interfered with the coal traffic, was removed during May and June, 1897. A contract was made May 10, 1897, for excavating the channel through the ledge in the Lower Narrows.

Money statement.

July 1, 1896, balance unexpended		$22,919.98
June 30, 1897, amount expended during fiscal year		8,137.67
July 1, 1897, balance unexpended		14,782.31
July 1, 1897, outstanding liabilities	$1,924.78	
July 1, 1897, amount covered by uncompleted contracts	9,750.00	
		11,674.78
July 1, 1897, balance available		3,107.53
Amount (estimated) required for completion of existing project		105,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

APPROPRIATIONS.

July 4, 1836	$5,000	August 2, 1882	$28,000
March 3, 1837	5,000	July 5, 1884	28,000
March 3, 1871	10,000	August 5, 1886	10,000
June 10, 1872	10,000	August 11, 1888	9,000
March 3, 1873	10,000	September 19, 1890	25,000
June 23, 1874	10,000	July 13, 1892	15,000
March 3, 1875	25,000	August 17, 1894	15,000
August 14, 1876	14,000	June 3, 1896	15,000
June 18, 1878	6,000		

Abstract of proposals, March 31, 1897.

No.	Name and address of bidder.	Price per cubic yard for removing ledge (1,300 cubic yards) situ.	Price per cubic yard for dredging (3,000 cubic yards) measured in scow.	Amount.
1	Robert H. Rogers, Plattsburg, N. Y.	$12.88	.....	$16,744
2	Simon J. Donovan, Winthrop, Mass.	7.50	.....	9,750
3	William D. Johnston, Philadelphia, Pa.	11.00	.....	14,300
4	Eastern Dredging Co., Boston, Mass.	.....	$0.85	2,550
5	Charles H. Souther, Boston, Mass.	.....	1.00	3,000

Contract for removing ledge made with Simon J. Donovan, May 10, 1897. Bids for dredging rejected as being too high.

List of contracts in force during the fiscal year ending June 30, 1897.

No.	Name and address of contractor.	Date of contract.	Subject of contract.	Price per cubic yard.	Date of approval.	Beginning of work.	Expiration.
1a	Andrew W. Bryne, West Medford, Mass.	Mar. 2, 1895	Removal of ledge.	$6.20	Mar. 8, 1895	May 1, 1895	Oct. 31, 1896.
2	Simon J. Donovan, Winthrop, Mass.	May 10, 1897	.....do	7.50	June 3, 1897	May 1, 1897	Dec. 31, 1897.

a Contract completed.

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COMMERCIAL STATISTICS.

Receipts and shipments.

Articles.	1891.	1892.	1893.	1894.	1895.	1896.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Apples	.....	150	.....	130	.....	150
Ashes	.....	.....	.....	105	88	31
Bricks	40,056	40,000	31,500	31,000	40,000	30,000
Coal	26,056	27,855	29,983	24,780	30,480	18,000
Cement, lime, and plaster	1,810	1,950	2,025	3,500	4,000	4,500
General merchandise	.....	.....	200	1,500	.....	.....
Iron	390	.....	.....	.....	.....	.....
Lumber	1,500	1,600	3,000	2,000	3,000	3,450
Phosphate	150	150	225	250	300	300
Potatoes	.....	.....	.....	.....	83	25
Sand (molding)	100	80	.....	150	200	300
Wood	.....	.....	.....	5,000	5,000	3,000
Total	70,062	71,785	66,933	68,415	83,151	59,755

Arrivals in calendar year 1896.

Sailing vessels:	
Coastwise, 400 to 500 tons	10
Coastwise, less than 400 tons	59
Barges	150
Steam tugs plying in the river, trips	150

A 20.

HARBOR OF REFUGE AT LITTLE HARBOR, NEW HAMPSHIRE.

The approved project and the report of progress of the work to June 30, 1896, will be found in the Report of the Chief of Engineers for 1897, Part I, page 41.

The expenditures during the fiscal year 1897 were $164.27. The operations consisted in widening the anchorage by dredging, under a contract dated May 4, 1897. Work was commenced June 24, 1897, and at the close of the fiscal year 4,829 cubic yards of material had been excavated.

Proposals for repairing the breakwater at Jerrys Point, damaged by storms, will be opened July 21, 1897.

About two-thirds of the proposed dredging has been accomplished, and the harbor is available. The work is intended as a harbor of refuge and is coming into use as such by small vessels.

Portsmouth is the nearest port of entry. There are defensive works at Jerrys Point, and there is a light at the end of each breakwater.

Money statement.

July 1, 1896, balance unexpended		$10,335.87
June 30, 1897, amount expended during fiscal year		164.27
July 1, 1897, balance unexpended		10,171.60
July 1, 1897, outstanding liabilities	$100.00	
July 1, 1897, amount covered by uncompleted contracts	8,925.00	
		9,025.00
July 1, 1897, balance available		1,146.60
Amount (estimated) required for completion of existing project		25,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

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APPROPRIATIONS.

August 5, 1886	$10,000	July 13, 1892	$30,000
August 11, 1888	20,000	August 17, 1894	10,000
September 19, 1890	40,000	June 3, 1896	10,000

Abstract of proposals for dredging March 31, 1897.

No.	Name and address of bidder.	Price per cubic yard (60,000 cubic yards), measured in scow.	Amount.
		Cents.	
1	Simon J. Donovan, Winthrop, Mass.	20	$12,000
2	Augustus B. Martin, Boston, Mass.	16⅔	10,000
3	Eastern Dredging Company, Boston, Mass.	15½	9,300
4	Charles H. Souther, Boston, Mass.	14⅞	8,925

Contract made with Charles H. Souther May 4, 1897.

Contract in force during the fiscal year ending June 30, 1897.

No.	Name and address of contractor.	Date of contract.	Subject of contract.	Price per cubic yard.	Date of approval.	Beginning of work.	Expiration.
				Cents.			
1	Charles H. Souther, Boston, Mass.	May 4, 1897	Dredging.	14⅞	May 20, 1897	July 1, 1897	Dec. 1, 1897

COMMERCIAL STATISTICS.

There is no commerce belonging to this harbor, and very little arriving thereat worthy of note. The harbor is for refuge, and during the year 1896 70 vessels, including coastwise, fishermen, and yachts, entered for shelter.

The following letter in reply to request for information for calendar year 1896 has been received:

LIFE-SAVING SERVICE, FIRST DISTRICT,
Portsmouth, N. H., February 8, 1897.

DEAR SIR: In compliance with your request of the 3d instant, I inclose herewith a letter from Captain Mayo, of the Jerrys Point (Little Harbor) life-saving station, which will give you the information sought; and also I herewith make statement to my personal knowledge gained by observation during the past year (1896) of the utility and advantage of the works and improvements at this harbor. During the month of May two coasting vessels were by the aid of the beacon lights on the breakwater able to make this harbor in the night during thick and heavy weather, the tide, wind, and sea being such they could not work into Portsmouth Harbor. One of them was deeply lumber laden, and had it not been for the improvements made, whereby she found safe shelter and plenty of water, she would have been a total loss.

The most of the vessels given by Keeper Mayo (sailing vessels) have sought its shelter under similar circumstances. During the past month the captains of five different size coasting schooners have visited the place, made soundings, took bearings, and were outspoken in their praise of the advantages of this harbor, and which they consider, with future improvements combined with Portsmouth Harbor, will make one of the best harbors of refuge along the coast. I have also heard the same from a large number of seafaring men, and they all express the hope that further improvements will be made, viz, widening channel anchorage, etc. From my own observations and personal knowledge of the place, I can but repeat what has already been said, and thus far it has been a haven of refuge to a good number. With further improvements, it will be sought by many.

Should further information be required, trusting you will inform me, I remain, very respectfully,

S. H. HARDING,
Superintendent First Life-Saving District.

Lieut. Col. A. N. DAMRELL,
Corps of Engineers, U. S. A.

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LIVE-SAVING SERVICE, FIRST DISTRICT,
Jerrys Point Station, February 8, 1897.

SIR: The keeper of Jerrys Point light-station has passed me a letter from Lieut. Col. A. N. Damrell, Corps of Engineers, Portland, Me. (to your address), wishing for a statement in reference to the benefits and advantages of the work of improvements at Little Harbor, New Hampshire. In reply, will say that I think the improvements are of much benefit to yachts, fishing vessels, small and medium sized coasting vessels. I also think the harbor will be used more in the future than it was in 1896, for the reason that vessels drawing 10 feet of water or less can come into Little Harbor with the wind northeast and ebb tide without much trouble when they could not work up into Portsmouth Harbor, and once they get into Little Harbor they will lay secure from all winds. The number of vessels that entered Little Harbor for shelter during the year 1896, since the lights were erected on the breakwaters, is as follows:

June, 2 coasting vessels, 8 yachts; July, 2 fishing vessels, 11 yachts; August, 5 fishing vessels, 19 yachts; September, 11 yachts; October, 8 fishing vessels; November, 3 fishing vessels; December, 1 fishing vessel.

Very respectfully,

A. A. MAYO, *Keeper.*

Supt. S. H. HARDING,
First Life-Saving District, Portsmouth, N. H.

A 21.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

The schooner *L. Holway*, a small wooden vessel, was sunk in Narraguagus Bay, May 30, 1896. The wreck was an obstruction to navigation, and in August, 1896, its removal was authorized. Mr. Henry M. Leighton, of Millbridge, Me., undertook to remove the wreck and destroy it for the sum of $160. He removed it from the path of navigation and secured it in a small cove, but the operation of destroying it has not yet been completed.

A 22.

PRELIMINARY EXAMINATION OF CHANDLERS RIVER, MAINE, WITH A VIEW TO ITS IMPROVEMENT BY DREDGING FROM ITS MOUTH TO THE WHARVES AT JONESBORO.

[Printed in House Doc. No. 43, Fifty-fifth Congress, first session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., April 30, 1897.

SIR: I have the honor to submit the accompanying report, dated April 22, 1897, by Lieut. Col. A. N. Damrell, Corps of Engineers, upon the results of a preliminary examination of Chandlers River, Maine, with a view to its improvement by dredging from its mouth to the wharves at Jonesboro, made to comply with the provisions of the river and harbor act of June 3, 1896.

Colonel Damrell states that the improvement desired is the deepening, widening, and straightening of the channel where necessary, so as to permit of the use of a larger class of vessels than is now possible, and that a channel 6 feet deep at mean low water, or 17 feet at mean high water, with a width of 93 feet at the upper end, increasing to 250 feet at the lower end (just above Looks Head), and the same width at the bends would be sufficient for the traffic.

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I concur with the district engineer in advising a survey of the river, estimated to cost $600, upon the results of which a more reliable opinion as to the extent of the improvement, justified by the commerce involved, can be formed.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF LIEUT. COL. A. N. DAMRELL, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Portland, Me., April 22, 1897.

GENERAL: I have the honor of submitting the following report upon the preliminary examination of "Chandlers River, with a view to its improvement by dredging from its mouth to the wharves at Jonesboro," provided for in the river and harbor act of June 3, 1896, and assigned to my charge by circular letter from the Chief of Engineers of June 16, 1896.

Chandlers River is a small stream discharging into Englishmans Bay about 30 miles west of the St. Croix. It is about 4¾ miles from the mouth to the head of navigation at Jonesboro. From the mouth up to a short distance above Looks Head (1¾ miles) there is not less than 15 feet depth at mean low water; in the next three-fourths of a mile, up to Deep Hole Point, the channel is divided, each branch being narrow, crooked, and with a depth of about 5 feet, and from there the channel is narrow and in places crooked, with a depth ranging from 11 feet at the lower end to 2 feet just below the wharves at Jonesboro, where the width between wharves on the opposite sides of the river is only 93 feet. The average rise of the tide is 11 feet.

The improvement desired is the deepening, widening, and straightening of the channel where necessary, so as to permit of the use of a larger class of vessels than is now possible up the river. As granite and paving blocks are the principal articles for shipment, the tonnage of the vessels is an important item for the profitable handling of the cargoes.

There are 7 paving-block quarries, one sawmill, and 2 quarries of excellent red granite near the river in the immediate vicinity of Jonesboro.

A channel 6 feet deep at mean low water, or 17 feet at mean high water, with a width of 93 feet at the upper end, increasing to 250 feet at the lower end (just above Looks Head), and the same width at the bends would be sufficient for the traffic. * * *

The amount of commerce for 1896 could not be obtained for the river. For 1895 it was about 18,000 tons. For the present year it will be considerably larger, as the Bodwell Granite Company alone expects to ship more than 10,000 tons.

I am of the opinion that a survey should be made to determine the exact cost of the improvement needed. The cost of a survey would be about $600.

Very respectfully, your obedient servant,

A. N. DAMRELL,
Lieut. Col., Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

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A 23.

PRELIMINARY EXAMINATION OF UNION RIVER, NEAR THE CITY OF ELLSWORTH, IN HANCOCK COUNTY, MAINE.

[Printed in House Doc. No. 6, Fifty-fifth Congress, first session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., March 10, 1897.

SIR: I have the honor to submit the accompanying copy of report, dated January 30, 1897, by Lieut. Col. A. N. Damrell, Corps of Engineers, upon the preliminary examination of Union River, near the city of Ellsworth, in Hancock County, Me., provided for by the river and harbor act of June 3, 1896.

This river was improved in 1871–72, so as to give a safe and well-marked channel with a minimum depth of 3 feet at mean low water, or 15 feet at mean high water, and width of about 150 feet at a low stage, at a cost of $29,390.54. An examination in 1888 and survey in 1889 showed that deposits of mill waste had seriously interfered with the channel improvement.

The act of June 3, 1896, besides directing this preliminary examination at Ellsworth, also provides for a survey of "Union River, for a deeper and broader channel," and moreover makes an appropriation of $15,000 for "improving Union River, Maine, by dredging."

As Congress has made appropriation for improving this stream, it has apparently determined the worthiness of this particular work. It is suggested that to preserve any improvement of Union River such legislation as will prohibit injuries to channel by further deposits of mill waste is necessary.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF LIEUT. COL. A. N. DAMRELL, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Portland, Me., January 30, 1897.

GENERAL: In accordance with instructions contained in your letter of June 16, 1896, I have the honor of submitting the following report upon the preliminary examination of Union River, provided for by the river and harbor act of June 3, 1896.

This river was improved in 1871–72 by the removal of over 75,000 cubic yards of mill waste, and more than 600 tons of bowlders, so as to give a safe and well-marked channel with a minimum depth of 3 feet at mean low water, or 15 feet at mean high water at a low stage of the river, and width of about 150 feet, at a cost of $29,390.54.

An examination made in 1888 and survey made in 1889 showed that the previous improvement had been completely destroyed by a new accumulation of mill waste.

My examination, made in 1896, showed the conditions about as reported in 1889, only perhaps a little worse. The map submitted at that time is apparently good at this time. The plan for improvement

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proposed is, in my opinion, a good one. The estimated total cost, $225,000, is approximately correct. The price per cubic yard for dredging can be reduced probably one-half, but the number of cubic yards that should be removed will be nearly or quite double.

No new survey need be made.

Unsuccessful efforts were made to obtain commercial statistics. They are probably about the same as in 1889, when they were as follows:

Total number of vessels	69
Total registered tonnage	6,437
Total number of entrances and clearances	682
Total tonnage for all entrances, etc	47,096

It has been reported to me that the practice of dumping mill waste in the river, which has apparently delayed any further improvement, has been stopped, but I know of no State law forbidding it, and the United States laws were apparently not made to cover navigable rivers above the head of navigation or the tributaries of navigable rivers, from which the trouble now comes.

Union River is not alone in this respect, for nearly all the rivers in this State on which improvements are under way or contemplated have been more or less injured from the deposit of mill waste, and the same rule should be applied to all.

Should Union River be improved, it is probable that appropriations will be needed for maintenance. It is impracticable to state what this sum would be, but it might approximate $10,000 per annum.

In my opinion improvements should be suspended on all rivers where it is evident that the work consists in removal of constantly recurring deposits of mill waste or other rubbish, until the United States laws in regard to deposits in navigable rivers are supplemented by State laws of similar character covering navigable rivers above the head of navigation, and tributaries of the same, from which the deposits are carried into the navigable waters.

In the particular case of Union River, as Congress has appropriated for its improvement, knowing the conditions, it has apparently determined the worthiness of the work.

Very respectfully, your obedient servant,

A. N. DAMRELL,
Lieut. Col., Corps of Engineers.

Brig. Gen. W. P. CRAIGHILL,
Chief of Engineers, U. S. A.

A 24.

PRELIMINARY EXAMINATION OF SOUTH CHANNEL OF BRANCH OF PENOBSCOT RIVER, MAINE, IN FRANKFORT, IN WALDO COUNTY, WITH A VIEW OF REMOVING AN OLD WRECK, AND ESTIMATE OF COST THEREOF.

[Printed in House Doc. No. 45, Fifty-fifth Congress, first session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., April 30, 1897.

SIR: I have the honor to submit the accompanying report of the 22d instant, by Lieut. Col. A. N. Damrell, Corps of Engineers, of the results of a preliminary examination of south channel of branch of Penobscot River, in Frankfort, in Waldo County, Me., with a view of remov-

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ing an old wreck, and estimate of cost thereof, made to comply with the requirements of the river and harbor act of June 3, 1896.

Colonel Damrell states that the wreck referred to was found to be in Marsh River, near its junction with the Penobscot, and is reported to be that of the schooner *Swan*. He is of opinion that it should be removed, and that a survey, estimated to cost $100, should be made to obtain data for preparation of specifications.

I concur in his views.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF LIEUT. COL. A. N. DAMRELL, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Portland, Me., April 22, 1897.

GENERAL: In accordance with instructions contained in circular letter of June 16, 1896, from the office of the Chief of Engineers, I have the honor of submitting the following report on the preliminary examination of "south channel of branch of Penobscot River, in Frankfort, in Waldo County, with view of removing an old wreck, and estimate of cost thereof," provided for by the river and harbor act of June 3, 1896.

The wreck was found to be in Marsh River, about 1 mile above its junction with the Penobscot, and about 900 feet from the Mount Waldo Granite Company's wharf, and it is reported to be that of the schooner *Swan*, sunk over fifty years ago, being loaded at the time with rough granite. As it lies, it is a dangerous and troublesome obstruction in navigable water used by vessels engaged in moving the product of large granite quarries in the immediate vicinity. * * *

The cost of removal of the wreck and rock with which it was loaded is estimated not to exceed $1,000, and may be much less.

The average annual output of the quarries is approximately estimated at 30,000 tons.

I am of the opinion that it should be removed. A survey should be made to obtain data for specifications, which could be made for about $100.

Very respectfully, your obedient servant,

A. N. DAMRELL,
Lieut. Col., Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

A 25.

PRELIMINARY EXAMINATION OF BOOTHBAY HARBOR, MAINE.

[Printed in House Doc. No. 46, Fifty-fifth Congress, first session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., April 30, 1897.

SIR: I have the honor to submit the accompanying copy of report, dated April 22, 1897, by Lieut. Col. A. N. Damrell, Corps of Engineers,

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upon the results of a preliminary examination of Boothbay Harbor, Maine, provided for by the terms of the river and harbor act of June 3, 1896.

Colonel Damrell states that the improvement desired is the widening of the 15-foot area in the upper harbor so as to bring that depth within reach of the wharves, and it is his opinion, which is concurred in by me, that Boothbay Harbor is worthy of improvement by the General Government, provided it be shown by a survey, estimated to cost $500, that such improvement can be effected at a reasonable cost.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF LIEUT. COL. A. N. DAMRELL, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Portland, Me., April 22, 1897.

GENERAL: In accordance with instructions contained in circular letter of June 16, 1896, from the office of the Chief of Engineers, I have the honor of submitting the following report upon the preliminary examination of Boothbay Harbor, provided for by the river and harbor act of June 3, 1896.

Boothbay Harbor is about 10 miles east of the Kennebec River. It is formed by the mainland on the north and east, a number of islands on the south, and Southport Island on the west. It is thoroughly protected, well lighted and buoyed, with not less than 30 feet of water over a large area up to McFarlands Island. Above this is what may be called the upper harbor, where vessels are loaded and unloaded, with a width at the lower end of about 2,000 feet and at the upper end of about 600 feet, with a length north and south of about 2,000 feet. It has a very contracted area, with a depth of from 30 feet at the lower end, shoaling up to about 15 feet at mean low water near the upper end. The rise of mean high water is 8.5 feet.

The improvement desired is to widen the 15-foot area so as to bring that depth within reach of the wharves. The wharves can not be carried out to the proper depth without destroying the harbor.

The conditions appear to be favorable for the improvement.

First a wharf line should be established around the harbor and the area included dredged out to the depth of 15 feet. The cost should not, in my opinion, exceed $40,000.

The amount of freight landed at and shipped from the harbor by steamers and sailing vessels drawing from 8 to 18 feet and from 200 to 600 tons each was estimated for the last fiscal year at 94,000 tons. The number of American and foreign vessels seeking refuge in the harbor during the same time was estimated at 1,144.

In consideration of the above, I am of the opinion that the harbor is worthy of improvement, provided a survey shows the improvement can be effected for the price stated.

The survey could be made for about $500.

Very respectfully, your obedient servant,

A. N. DAMRELL,
Lieut. Col., Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

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A 26.

PRELIMINARY EXAMINATION OF OYSTER RIVER, NEW HAMPSHIRE.

[Printed in House Doc. No. 40, Fifty-fifth Congress, first session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., April 29, 1897.

SIR: I have the honor to submit the accompanying report of April 22, 1897, by Lieut. Col. A. N. Damrell, Corps of Engineers, of the results of a preliminary examination of Oyster River, New Hampshire, made to comply with the provisions of the river and harbor act of June 3, 1896.

Colonel Damrell is of opinion that the locality is worthy of improvement, provided a survey, estimated to cost $200, should show that the improvement could be made at small cost.

I concur in his views to the extent of advising a survey of the locality, upon the results of which a more reliable opinion as to the extent of the improvement, justified by the commerce involved, can be formed.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF LIEUT. COL. A. N. DAMRELL, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Portland, Me., April 22, 1897.

GENERAL: I have the honor of submitting the following report upon the preliminary examination of Oyster River, New Hampshire, provided for by the river and harbor act of June 3, 1896, and assigned to the charge of this office by circular letter from the Chief of Engineers of June 16, 1896.

Oyster River is a small stream emptying into Little Bay. Its length from its mouth up to Durham, N. H., the head of navigation, is about 1½ miles. The channel has a minimum depth of 3 feet at mean low water.

The improvement desired is to deepen, widen, and straighten the channel for a distance of one-half mile at and just below Durham, so as to give a minimum depth of 5 feet at mean low water, with navigable width and easy bends. * * * The present commerce on the river amounts to about 4,300 tons, and the probability is that this would be doubled in the immediate future if the improvement is made.

I am of the opinion that the river is worthy of improvement, provided a survey should show that the improvement could be made at small cost. The cost of the survey would be about $200.

A copy of the report of Mr. J. W. Walker, by whom the examination was made, is transmitted herewith.

Very respectfully, your obedient servant,

A. N. DAMRELL,
Lieut. Col., Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

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REPORT OF MR. J. W. WALKER, SURVEYOR.

PORTLAND, ME., *March 6, 1897.*

COLONEL: I have the honor to submit the following report upon a preliminary examination of Oyster River, New Hampshire, made under your direction during October 23, 1896. The portion of the river examined extends from the head of navigation in the town of Durham to its mouth, where it empties into Little Bay.

The universal expression of those with whom I conversed, interested in the commerce of this river, is to have the channel straightened and deepened from its mouth to the wharves at Durham, a distance of about 1½ miles.

The first obstruction, about 1 mile above the mouth of the river, is a shoal having an available depth of 3 feet at mean low water for a distance of about 500 feet. Immediately above this shoal the channel deepens to 6 feet, but is narrow and tortuous. The improvement desired is to deepen the channel through the shoal to 5 feet at mean low water, and straighten the channel above the shoal to the wharves by dredging. Three brickyards located on this river ship their entire output to Boston by river, besides the shipment of wood for the manufacture of brick. This is the only outlet for a large section of country except by wagon road for a distance of about 3 miles to the railroad. It is claimed the commerce of the river would be much greater if these improvements should be made.

The commerce on the river for the year ending December 31, 1896, is as follows:

	Tons.
Brick	3,375
Coal	150
Wood	750
Total	4,275.

* * * * * * *

Very respectfully, your obedient servant,

J. W. WALKER, *Surveyor.*

Lieut. Col. A. N. DAMRELL,
Corps of Engineers, U. S. A.

A 27.

SURVEY OF ST. CROIX RIVER, BELOW CALAIS, BETWEEN MAINE AND NEW BRUNSWICK.

[Printed in House Doc. No. 55, Fifty-fifth Congress, first session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., May 18, 1897.

SIR: I have the honor to submit the accompanying report of May 7, 1897, by Maj. R. L. Hoxie, Corps of Engineers, of the results of a survey of "St. Croix River, below Calais, between Maine and New Brunswick, submitting estimate of the cost of said improvement and the amount the United States ought equitably to bear," made to comply with the requirements of the river and harbor act of June 3, 1896.

The plan of improvement presented contemplates providing a channel 12 feet deep at mean low tide, and 200 feet wide at the lower end, near Hills Point, contracting gradually, except at bends, to 100 feet at the upper end, near the toll bridge at Calais, the cost of which is estimated to be $200,000, with a small annual expenditure for maintenance.

If the resulting benefit to commerce is to be the measure of the division of cost between the two countries, it is estimated by the local engineer that the United States should bear nine-tenths of the expense and the Dominion of Canada one-tenth. But if each Government is to pay for the work to be done within the limit of its own territory, then the cost of the improvement should be equally divided between the United States and Canada.

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Major Hoxie states that the present condition of the channel which needs improvement is due in a great measure to the accumulation of refuse thrown into the stream by sawmills on both sides of the river. In his opinion the Canadian Government will not appropriate money for improvement of this river until preservation of channel is assured by the absolute suppression of the practice of throwing mill waste into it, and the United States should take the same position. Subject to this condition, however, he considers the proposed improvement to be eminently worthy.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF MAJ. R. L. HOXIE, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Portland, Me., May 7, 1897.

GENERAL: I have the honor to submit the following report of a survey of "St. Croix River, below Calais, between Maine and New Brunswick, submitting estimate of the cost of said improvement and the amount the United States ought equitably to bear," provided for by the river and harbor act of June 3, 1896, and assigned to the charge of this office by the Chief of Engineers September 5, 1896.

A thorough survey of the river was made in 1888, the report and map of same being submitted December 20, 1889. An examination in November, 1896, showing that but little change had taken place, a resurvey was considered unnecessary.

The depth and width of channel in this river from the mouth to Hills Point, about 2½ miles below Calais, appear to satisfy the requirements of existing navigation. Between Calais and Hills Point there are several shoals, composed principally of mill waste, on which the depth varies from 9½ to 1½ feet at mean low tide, the mean rise being about 19.9 feet, while the channel in places is narrow and crooked. The project submitted in 1889 for a channel 12 feet deep at mean low tide and 200 feet wide at the lower end, near Hills Point, contracting gradually, except at bends, to 100 feet at the upper end, near the toll bridge at Calais, is thought to be the improvement needed, the object being to allow steamers to land at Calais, and vessels to take on full loads there instead of loading partially at Calais and then dropping down to deep water to complete the loading, as they are obliged to do at present. The estimated cost of carrying out this project is $200,000, and there will probably be an annual cost for maintenance. It is thought the cost of maintenance will be comparatively small, but it can not now be estimated.

The annual commerce directly interested in and to be benefited by the improvement is estimated as follows:

At Calais, on the American side, 60,000,000 feet of lumber, 10 cargoes of granite, 100 cargoes of general merchandise, 50,000 tons of coal, 40,000 bushels of corn, and a daily line of steamers to Eastport.

At St. Stephens, on the Canadian side, 5,000,000 feet of lumber, 5,000 tons of coal, 5 cargoes of sugar and molasses, and two lines of steamers making trips to the islands during the summer season.

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This gives approximately nine-tenths of the tonnage to be benefited American tonnage, and one-tenth Canadian. On the other hand, the work to be done in the river channel is approximately the same in amount and character on either side of the boundary line between the United States and Canada. If the resulting benefit to commerce is to be the measure of the division of cost between the two countries, the United States should bear nine-tenths of this expense and the Dominion of Canada one-tenth. If each Government is to pay for the work to be done within the limits of its own territory, then the cost of the improvement should be equally divided between the United States and Canada.

The present condition of the channel, which needs improvement, is due in great measure to the accumulation of refuse thrown into the stream by sawmills on both sides of the river. It is understood that to some extent the practice has been checked, and only sawdust is permitted to enter the river. The principal element of uncertainty as to the cost of maintaining the channel when once created is due to the fact that this practice continues, and that there seems to be no adequate means of preventing it. It is believed that the Canadian Government will not consent to appropriate money for the improvement of this river until the preservation of the channel is assured by the absolute suppression of the practice of throwing mill waste into it, and it is thought that the United States should take the same position with respect to this improvement. Subject to this condition, it is thought the proposed improvement is eminently worthy, and should be undertaken as soon as a satisfactory basis of division of cost can be arranged with the Dominion Government.

The report of Mr. W. F. Robinson, assistant engineer, by whom the examination was made, is forwarded herewith.

Very respectfully, your obedient servant,

R. L. HOXIE,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

REPORT OF MR. W. F. ROBINSON, ASSISTANT ENGINEER.

PORTLAND, ME., *May 1, 1897.*

MAJOR: I have the honor to submit the following report of an examination of the St. Croix River, made in November, 1896, under directions of Lieut. Col. A. N. Damrell.

It was found upon examination that so little change had taken place since the last survey was made, in 1889, that it was not thought necessary to make an extended survey at this time.

A tracing of the map made from the survey of 1888 was transmitted to the Department December 20, 1889. Formerly there was a good channel, with sufficient depth of water, from Eastport to the toll bridge at Calais, but now, from the accumulation of mill waste, the condition of the channel is as follows:

There is a good channel from Eastport up to Hills Point; just above this point there is a shoal extending across the river, about 300 feet long, on which there is about 9.5 feet of water at mean low water; from here to the old wharf on the Canadian side there is 12 feet or more, but the channel is narrow and crooked, especially near the old wharf; from here to the lower wharf of the international steamers, on the American side, about 8 feet is found; from here to the wharves at Calais there is a general depth of about 6 feet, and along in front of the wharves at Calais, up to the bridge, the depth varies from 6 to 1.5 feet. The material is mud, mixed with sawdust, slabs, and edgings.

It is claimed that little else than sawdust is allowed to go into the river at the present time. From comparisons made of the soundings taken at the present time and those taken in 1873 and 1889, when surveys were made, it is found that there has been but little shoaling in the channel except at a point near Hills Point, where no

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shoal was found in 1873, and in 1889 a depth of 10.5 feet was found, and at present about 9.5 feet was obtained.

In conversation with Mr. Ganong, member of Parliament from St. Stephens, he said that he did not think that the Dominion of Canada would appropriate any money to deepen the channel in this river as long as any mill waste was allowed to go into the river.

The mills are all above the head of navigation, and for the most part on the American side. It has been proposed to improve this river so as to give a channel from Hills Point to near the toll bridge with 12 feet of water at mean low water. This would give about 9 feet at extreme low water, which would allow the steamers to land at the upper landing at all stages of water, and also would allow the larger lumber vessels to load at the wharves, which they are unable to do at present, having to partly load at the wharves and then drop down below Hills Point and finish loading by lighter.

The proposed channel could be about 200 feet wide at the lower end, narrowing to 100 feet in front of Calais to avoid ledges, and would be approximately one-half in the American and one-half in Canadian waters.

The estimated quantities are as follows:

480,000 cubic yards (in place) mud and mill waste, at 40 cents	$192,000
Engineering expenses	8,000
Total	200,000

By comparing the amount of business done on the river by Americans and the amount done by Canadians, it is found that about nine-tenths is done by Americans, and in vessels owned in the United States.

The commercial statistics obtained are as follows:

Calais:
- 60,000,000 feet of lumber shipped yearly.
- 10 cargoes of granite.
- 50,000 tons of coal received.
- 100 cargoes general merchandise.
- 40,000 bushels corn.
- A daily line of steamers from Calais to Eastport in summer, and in winter as often as the weather will permit.

St. Stephens:
- 5,000,000 feet lumber yearly.
- 5,000 tons coal received.
- 5 cargoes sugar and molasses received from the West Indies.
- 2 lines steamers making trips to the islands during the summer season.

I desire to submit, as a part of this report, a letter from W. S. Waldron, deputy collector at Calais, and to call attention to the statement made therein about the steamers being delayed on account of the shoal water.

The mean rise of tide at Calais is about 20 feet.

Very respectfully,

W. F. ROBINSON, *Assistant Engineer.*

Maj. R. L. HOXIE,
Corps of Engineers, U. S. A.

LETTER OF DEPUTY COLLECTOR OF CUSTOMS, CALAIS, ME.

OFFICE OF THE COLLECTOR OF CUSTOMS,
Calais, November 25, 1896.

DEAR SIR: The tonnage of vessels at this port and those arriving from other ports from January 1, 1896, to this date, November 25, amounts in the aggregate to 51,120 tons.

This tonnage is our lumber and coal vessels, principally the lumber carriers.

In addition to this are the steamboats that ply on the river, some of them making daily trips most of the year to and from Eastport and other points along the river; also, the steam tugs towing vessels.

The present season has been a very dull one here for shipping, and in all the carrying trade a considerable falling off has been the result.

A good average year would show fully 25 per cent more business.

In connection with this there is one fact regarding the condition of our river that I wish to call to your attention, viz, the accumulation of sawdust and other matter which prevents the steamers and other vessels from making their docks at proper times. The river steamer *Rose Standish* has to wait until the tide is from two to two

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and one-half hours flood before landing her freight at the upper dock, and often has to wait below the lower dock for flood tide to land her passengers.

Dredging our river, or a portion of it, in this immediate vicinity would be a great advantage to all who do business on the St. Croix.

Trusting this communication will give you some of the desired information,

I am, very respectfully,

W. S. WALDRON, *Deputy Collector.*

Mr. W. F. ROBINSON, *Assistant Engineer.*

A 28.

SURVEY OF MACHIAS RIVER, MAINE, FROM MACHIAS TO MACHIASPORT.

[Printed in House Doc. No. 48, Fifty-fifth Congress, first session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., April 29, 1897.

SIR: I have the honor to submit the accompanying report of April 23, 1897, by Lieut. Col. A. N. Damrell, Corps of Engineers, of the results of a survey of Machias River, Maine, from Machias to Machiasport, made to comply with the requirements of the river and harbor act of June 3, 1896.

A project for improvement of this locality was completed in 1877, and in 1894 a survey was made and a new project for improvement was submitted under date of January 9, 1895.

In view of an examination made in November, 1896, which showed that the survey of 1894 and the project and estimate submitted in 1895 were good still, a new survey was deemed an unwarranted expense, and Colonel Damrell again presents the project proposed in 1895, which is to open a channel 125 feet wide and 7 feet deep at mean low tide (about 20 feet at high tide), except at and above Middle Rock, estimated to cost $50,000.

In the opinion of Colonel Damrell the river is worthy of improvement, but it is reported that mill waste is still allowed to go into the river both at Machias and above, which would again fill up in time any channel that might be dredged.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF LIEUT. COL. A. N. DAMRELL, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Portland, Me., April 23, 1897.

GENERAL: I have the honor of submitting the following report of a survey of Machias River, Maine, from Machias to Machiasport, provided for by the river and harbor act of June 3, 1896, and assigned to my charge by letter from the office of the Chief of Engineers of September 5, 1896.

A survey of this river was made in 1872, and a project for its improvement, modified in 1876, was completed in 1877, at a cost of $32,000. The project, as modified, consisted in removing Middle Rock, in front of the

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wharves at Machias, to a plane one-half a foot below mean low water and opening a channel between Machias Falls and the drawbridge 100 feet wide and 6 feet deep at mean low water.

In 1894 another survey was made and a report was forwarded from this office January 9, 1895. This survey showed that the improvement previously effected, except at Middle Rock, had been almost completely destroyed by fresh accumulations of refuse from sawmills at and above Machias Falls.

As an examination made in November, 1896, showed that the survey of 1894 and the project and estimate submitted in 1895 were good still, no material change having taken place, a new survey was deemed an unwarranted expense.

The project, then, which is now again proposed is to open a channel 125 feet wide and 7 feet deep at mean low tide (about 20 feet at high tide), except at and above Middle Rock, where it is to be as shown in the report above mentioned.

The estimated cost of the improvement is $50,000. The annual commerce amounts to about 20,000,000 feet of lumber, 1,000 cords of wood, 3,000 tons of coal, 2,000 barrels of flour, 70,000 bushels of corn, 1,000 barrels of apples, and several cargoes of general merchandise. In 1896 some 636 vessels loaded at Machias up to November 25.

The river is worthy of improvement, in my opinion, but it is reported that mill waste is still allowed to go into the river, both at Machias and above, which would again fill up in time any channel that might be dredged. The annual cost of maintenance, however, can not be estimated with any degree of accuracy, and it might be so much as not to be warranted by the benefit to be obtained to commerce.

A copy of the report of Mr. W. F. Robinson, assistant engineer, by whom the examination was made, is appended hereto.

Very respectfully, your obedient servant,

A. N. DAMRELL,
Lieut. Col., Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

REPORT OF MR. W. F. ROBINSON, ASSISTANT ENGINEER.

PORTLAND, ME., *January 15, 1897.*

COLONEL: I have the honor to submit the following report of an examination of the Machias River, Maine, made in November, 1896, under instructions received from you.

A survey was made of this river in 1894, a blue print of which was transmitted to the Department January 9, 1895. It was found that no material change in the condition of the river has occurred since that survey was made; therefore a resurvey was deemed unnecessary, and I see no reason for making any change in the estimate as made at that time. Mill waste is still being allowed to go into the river both at Machias and at the mills farther up the river.

The following commercial statistics were obtained:

There are shipped about 20,000,000 feet of lumber and 1,000 cords of wood yearly from Machias, and there are received as follows: 3,000 tons coal, 2,000 barrels flour, 70,000 bushels corn, 1,000 barrels apples; besides, many of the vessels carrying lumber bring cargoes of general merchandise.

Vessels drawing 16 feet of water can reach Machias on the high tide.

In 1896, 636 vessels loaded at Machias up to November 25.

Very respectfully, your obedient servant,

W. F. ROBINSON, *Assistant Engineer.*

Lieut. Col. A. N. DAMRELL,
Corps of Engineers, U. S. A.

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A 29.

SURVEY OF BANGOR HARBOR AND PENOBSCOT RIVER, INCLUDING MOUTH OF KENDUSKEAG RIVER, MAINE.

[Printed in House Doc. No. 49, Fifty-fifth Congress, first session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., May 3, 1897.

Sir: I have the honor to submit the accompanying report of April 23, 1897, with three maps,* by Lieut. Col. A. N. Damrell, Corps of Engineers, of the results of a survey of Bangor Harbor and Penobscot River, Maine, including mouth of Kenduskeag River, made to comply with the requirements of the river and harbor act of June 3, 1896.

Under former projects for improvement of this locality a good, navigable, safe channel of 22 feet up to Winterport, of 12 feet up to above Stern's mill, and 11 feet up to Bangor, at extreme low tide, has been obtained, and Colonel Damrell states that what is now needed is the dredging of a channel 90 feet wide and 2 feet deep at extreme low tide, or 15 feet at ordinary high tide, in Kenduskeag River from its mouth up to Kenduskeag Bridge, and deepening the harbor of Bangor in front of the Boston and Bangor steamboat wharf to 11 feet from the harbor line out, estimated to cost:

For Kenduskeag Channel	$10,680.45
For the other work	17,940.45
Total	28,620.90

Colonel Damrell is of opinion that the river is worthy of the improvement proposed.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF LIEUT. COL. A. N. DAMRELL, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Portland, Me., April 23, 1897.

GENERAL: I have the honor of submitting the following report upon the survey of Bangor Harbor and Penobscot River, Maine, including mouth of Kenduskeag River, provided for by the river and harbor act of June 3, 1896, and assigned to my charge by letter from office of the Chief of Engineers of September 5, 1896:

The improvement of this river commenced in 1870, and under various projects the sum of $337,935.53 has been expended and the following results obtained: Widening and deepening of the channel at Bangor from a depth of 6 feet to 11 feet at extreme low tide for a width of 360 feet; the dredging of a shoal near Stern's mill to 12 feet, and of the shoal just below Stern's mill to the same depth; the removal of rocks, ledges, and other obstructions; the dredging of a shoal above Bucksport to 22 feet, and giving generally a good, navigable, safe channel of 22 feet up to Winterport, of 12 feet up to above Stern's mill, and 11 feet up to Bangor at extreme low tide.

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* Not reprinted. Printed in House Doc. No. 49, Fifty-fifth Congress, first session.

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The present survey was limited to the locations where there were existing obstructions to navigation and showed that the work previously done had been well maintained, that what was needed now is the dredging of a channel 90 feet wide and 2 feet deep at extreme low tide, or 15 feet at ordinary high tide, in Kenduskeag River from its mouth up to Kenduskeag Bridge, and deepening the harbor of Bangor in front of the Boston and Bangor steamboat wharf to 11 feet from the harbor line out, the estimated cost of which would be for the—

Kenduskeag Channel	$10,680.45
And for the other work	17,940.45
Total	28,620.90

A shoal at Stern's mill has been complained of, but as it is outside of the channel necessary for general navigation, and apparently for the benefit only of the mills at that point, it has not been considered.

The amount of commerce on the portion of the river for which the above improvement is projected is estimated at 730,240 tons annually.

I am of the opinion that the river is worthy of the improvement proposed.

A copy of the report of Mr. J. W. Walker, by whom the survey was made, is appended hereto, and tracings of three maps, showing the locations examined and surveyed and proposed improvements, are forwarded in a separate roll.

Very respectfully, your obedient servant,

A. N. DAMRELL,
Lieut. Col., Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

REPORT OF MR. J. W. WALKER, SURVEYOR.

PORTLAND, ME., *February 11, 1897.*

COLONEL: I have the honor to submit the following report of survey of Penobscot River, Maine, made under your directions, from November 9 to December 4, 1896, at Bangor Harbor, including the mouth of Kenduskeag Stream, and between Stern's mills and Crosbys Narrows; also through Frankfort Flats and High Head.

The report is accompanied by the following maps:

Sheet No. 1, Bangor Harbor, including the mouth of Kenduskeag Stream, drawn to a scale of 1:2000.

Sheet No. 2, between Stern's mills and Crosbys Narrows, drawn to a scale of 1:2000.

Sheet No. 3, channel through Frankfort Flats and at High Head, drawn to a scale of 1:5000.

Your verbal instructions, according to which the survey was made, were:

First. To find out the nature, extent, and locality of existing obstructions to navigation and make an estimate of cost of their removal.

Second. For what purpose is it desired to have the mouth of Kenduskeag Stream improved and the depth of water required?

Bangor Harbor, including mouth of Kenduskeag Stream.—The plane of reference to which the soundings are reduced is the extreme low water, as determined from previous surveys, which is about 3 feet below the level of average low-water stages of the river. Soundings were located by keeping the sounding boat on a fixed range and taking the intersection angle with a transit. The depths were measured with a 10-pound lead on a brass chain, graduated to feet and tenths. The tide gauge was set with its zero at extreme low water.

For comparison, the area of the main ship channel heretofore dredged to 11 feet at extreme low water is section lined, and from the soundings on the accompanying map it is evident that the depths have not materially changed since the improvement was completed. A slight shoal of soft material has formed on the eastern edge of the dredged channel, from Joseph Oakes's shipyard down to the ferry land-

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ing. The deposit is the result of the wharves above checking the current, causing eddies below them, which extend down to the ferry slip. The shoal is so slight as to give no trouble to navigation.

Mr. Austin, president of the Boston and Bangor Steamboat Company, complained of the ledge in front of their wharf as not having the necessary depth of water over it for their steamers during the low stages of the river in dry seasons. The steamboats ground on the ledge while at the wharf, often delaying their departure.

This company's wharf extends into the river to the established harbor line, having a depth of extreme low water from 6 feet at the guard pile to 8 feet, at a distance of 30 feet, measured out from the guard pile. The bottom consists of points of ledge filled in between with gravel and hard clay. The portion of the ledge having been removed to the level of 7 feet at extreme low water, is represented on the drawing by section lining.

It was represented to me that the railroads occupy, on the Bangor side, all the wharves excepting those from the mouth of Kenduskeag Stream down to the planing-mill wharf; distance about 1,400 feet.

A general desire for better shipping facilities is expressed. It is desired to improve the Kenduskeag Stream up to Kenduskeag Bridge. The European and North American Railway crosses the stream at its mouth over a double drawbridge, having an opening on the east side of the guard pier of 34 feet and on the west side of 35 feet. Between the railroad bridge and Kenduskeag Bridge, on both sides, wharves are built out to nearly a straight alignment. On the west side the city has a public landing. These wharves are occupied principally by merchants having their buildings extend back and front on the street parallel to the stream. A large amount of the shipping of Bangor Harbor passes into the Kenduskeag Stream. During the past season 494 vessels of all classes passed through the drawbridge. The heaviest draft vessel drew 14.3 feet.

The material forming the bottom of this stream is sand, gravel, and small bowlders mixed with hard marl or clay. The present elevation of the bottom is from 1 to 7 feet above extreme low water.

To dredge a channel 90 feet wide, having a depth of 2 feet at extreme low water or 15 feet at ordinary high stages of the river, will require the removal of 32,365 cubic yards. About one-half of this amount can be placed on dumping grounds back of the harbor line established in 1877.

Between Stern's mills and Crosbys Narrows.—On the east side of the 12-foot contour of survey of 1872–73, 1883, 1890, and 1893 is represented, also, the area dredged in 1890 and 1891. In comparing the contour of previous surveys with that of the present survey, it is found to have receded toward the bank, giving a channel width of 300 feet down to the first jetty due to scouring force of the current, produced from contraction of cross section of river. Below the first jetty a deposit of soft material of about 1 foot depth has formed over the dredged areas of 1890 and 1891. The 12-foot channel now is 300 feet wide, and when completing the dredged area it was 400 feet wide.

It is evident that the contraction of cross section is not yet sufficient to keep the channel clear to the desired depth.

The proprietor of Stern's mills called my attention to the point of shoal near this property. He claims the dredging done in 1892 was not carried up river at a point where downstream navigation, especially rafted lumber, could during ebb tide leave the main channel and reach the mill wharf before drifting by.

The shoal consists of edgings, slabs, and sawdust mixed with sand.

Here the ship channel is comparatively straight, the cross section of river about normal, and for the easy and safe passage of all classes of navigation the conditions are better than at some other parts of the river.

Channel through Frankfort Flats and at High Head.—The plane of reference to which the soundings are reduced is the mean low water as determined from previous surveys.

The soundings were taken on the same ranges as survey of 1894, and for further comparison the 22-foot contour of 1887 and 1894 is given, also areas dredged to 22 feet at mean low water in 1890 and 1894.

Through Frankfort Flats the survey shows a good channel, not less than 300 feet wide, having a depth of water not less than 22 feet at mean low water.

At High Head there is a break in the 22-foot contour for a distance of 500 feet. On the crest of this shoal, which crosses the channel, there is 19.3 feet of water at mean low tide.

It is the general opinion among local steamboat pilots and persons most interested in the improvement of this river that the condition of the channel at these places gives no trouble to navigation. As long as the shoals are formed of light material, easily acted upon by the current, dredging will not establish a better channel; and the construction of jetties is objectionable to the smaller class of sailing vessels that can not afford the expense of being towed.

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RECAPITULATION.

To dredge a channel in Kenduskeag Stream having a width of 90 feet with a depth of 2 feet at extreme low water or 15 feet at ordinary high-water stage of the river requires the removal of 32,365 cubic yards measured in situ, at 30 cents per cubic yard	$9,709.50
To deepen the harbor in front of Boston and Bangor steamboat wharf to a depth of 11 feet at extreme low water will require the removal of 1,311 cubic yards of ledge measured in situ, at $12 per cubic yard	15,732.00
And 1,925 cubic yards of gravel and clay measured in situ, at 30 cents per cubic yard	577.50
	26,019.00
Contingencies and incidentals 10 per cent	2,601.90
Total	28,620.90

Commercial statistics of Penobscot River at Bangor and Bucksport are herewith submitted.

Very respectfully, your obedient servant,

J. W. WALKER, *Surveyor.*

Lieut. Col. A. N. DAMRELL,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS, BANGOR HARBOR.

Receipts and shipments.

	Tons.
Bricks	2,813
Brimstone	300
Coal	160,303
Farm produce	1,470
Fish and oysters	113
Flour, grain, and feed	16,412
Fertilizer and plaster rock	2,918
General merchandise	36,205
Hay and wood	4,060
Iron	2,460
Ice	197,000
Lime and cement	4,139
Lumber	280,895
Molding sand and potters' clay	1,397
Molasses and salt	2,768
Oil	9,380
Paving stone, granite, and slate	2,347
Shooks and spool wood	5,260
Total	730,240

COMMERCIAL STATISTICS, PORT OF BUCKSPORT.

Receipts and shipments.

	Tons.
Coal	3,000
Fish	110
Flour, grain, and feed	1,525
Fertilizer	2,000
Lumber	5,000
Miscellaneous	91,600
Hides	900
Wood	1,000
Salt	5,300
Paving stone and granite	65,000
Total	175,435

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A 30.

SURVEY OF HARRASEEKET RIVER, MAINE.

[Printed in House Doc. No. 47, Fifty-fifth Congress, first session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., May 1, 1897.

SIR: I have the honor to submit the accompanying report of April 23, 1897, by Lieut. Col. A. N. Damrell, Corps of Engineers, of the results of a survey of Harraseeket River, Maine, made to comply with the requirements of the river and harbor act of June 3, 1896.

Under appropriations heretofore made for improvement of this river a channel was obtained with a width of 90 feet and a depth of 14 feet at high tide, a central cut 70 feet wide having a depth of 17 feet at high tide.

Colonel Damrell reports that an examination showed that there was no necessity for a survey, and none was made. He states that a channel 70 feet wide and 20 feet deep at high tide can be obtained at an estimated cost of $8,000, but as the prospective commerce upon which the previous improvement was based has not developed, and as there seems to be no immediate prospect of it, it would seem that further improvement might be deferred until there should appear to be a need for it.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. A.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF LIEUT. COL. A. N. DAMRELL, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Portland, Me., April 23, 1897.

GENERAL: I have the honor of submitting the following report of a survey of the Harraseeket River, Maine, provided for by the river and harbor act of June 3, 1896, and assigned to my charge by letter from the office of the Chief of Engineers of September 5, 1896.

A survey of this river was made in 1881, and a project was submitted for a channel 60 feet wide and 3 feet deep at mean low water up to Freeport, at an estimated cost of $13,000.

A new survey was made under the river and harbor act of 1888. The report was submitted in June, 1889, submitting a project for a channel 5 feet deep at mean low water, about 14 feet at high tide, which was adopted. With the $31,000 appropriated a channel was obtained with a width of 90 feet and a depth of 14 feet at high tide, a central cut 70 feet wide having a depth of 17 feet at high tide. A basin was dredged in front of the wharves at Freeport to the full depth, and two dolphins were constructed to mark the channel.

As an examination showed that there was no necessity for a survey, none was made. A channel of 70 feet width and 20 feet deep at high tide can be obtained at an estimated cost of $8,000, but as the prospective commerce upon which the previous improvement was based

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has not developed, and as there seems to be no immediate prospect of it, it would seem that further improvement might be deferred until there should appear to be a need for it. The present commerce is confined to a single small steamer to and from Portland, Me.

The report of Mr. W. F. Robinson, by whom the examination was made, is appended hereto, and a tracing of a map* showing completed channel, proposed channel, and table of borings is forwarded in a separate roll.

Very respectfully, your obedient servant,

A. N. DAMRELL,
Lieut. Col., Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

REPORT OF MR. W. F. ROBINSON, ASSISTANT ENGINEER.

PORTLAND, ME., *January 15, 1897.*

COLONEL: I have the honor to submit the following report of an examination of the dredged channel in Harraseeket River, Maine, made in October, 1896, under your direction, and to submit a tracing drawn to the scale of 1:2,000:

In 1894 a channel was dredged from Westons Point, in the Harraseeket River, to Freeport Landing, to a depth of 5 feet at mean low tide and a width of 90 feet. In 1895 a central cut 70 feet wide and 8 feet deep was made.

A series of soundings were made from the turning basin at Freeport Landing to Westons Point, and it was found that the channel had maintained the depth of 8 feet at mean low tide. The sides of the banks have caved in somewhat, making a flatter slope, but for all practical purposes the channel is in as good condition as when work on it was finished.

It is proposed to deepen the channel 3 feet on the line of the 70-foot cut, so as to give 11 feet at mean low tide and a width of 70 feet.

The estimated cost is as follows:

35,000 cubic yards, at 20 cents	$7,000
Contingencies	1,000
Total	8,000

The material is believed to be clay. A table of borings is shown on tracing, showing depth and character of material.

The commerce using this channel at present is a line of daily steamers to and from Portland, Me.

Very respectfully, your obedient servant,

W. F. ROBINSON, *Assistant Engineer.*

Lieut. Col. A. N. DAMRELL,
Corps of Engineers, U. S. A.

A 31.

SURVEY OF ROYAL RIVER, MAINE.

[Printed in House Doc. No. 44, Fifty-fifth Congress, first session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C. May 3, 1897.

SIR: I have the honor to submit the accompanying report of April 23, 1897, by Lieut. Col. A. N. Damrell, Corps of Engineers, of the results of a survey of Royal River, Maine, made to comply with the requirements of the river and harbor act of June 3, 1896.

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* Not printed.

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Colonel Damrell states that the improvement desired is the deepening of the present 6-foot channel to 7 feet at mean low water, and to widen it where it is narrow from Yarmouth down about one-third of a mile, which he estimates will cost about $4,400.

In the opinion of Colonel Damrell, the commerce, both present and prospective, is so small that the expenditure of even the amount required for the improvement would not be justified by the interests involved.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF LIEUT. COL. A. N. DAMRELL, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Portland, Me., April 23, 1897.

GENERAL: I have the honor of submitting the following report of a survey of Royal River, Maine, provided for by the river and harbor act of June 3, 1896, and assigned to my charge by circular letter from the office of the Chief of Engineers of September 5, 1896.

The survey shows there is at present a channel with 6 feet depth at mean low water from the mouth up to the head of navigation—about 3 miles. The improvement desired is to deepen this to 7 feet and to widen it where it is narrow from Yarmouth down about one-third of a mile, the depth below being already sufficient.

The cost of the improvement would be about $4,400. The amount of commerce on the river is only about 2,000 tons annually, and I understand there is not much prospect of an increase hereafter.

The commerce is so small, both present and prospective, that in my opinion the expenditure of even the small amount required for the improvement would not be justified.

The report of the assistant engineer, W. F. Robinson, is appended, and a tracing of a map* of the river is forwarded in a separate roll.

Very respectfully, your obedient servant,

A. N. DAMRELL,
Lieut. Col., Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

REPORT OF MR W. F. ROBINSON, ASSISTANT ENGINEER.

PORTLAND, ME., *January 15, 1897.*

COLONEL: I have the honor to submit the following report upon the survey of Royal River, Maine, made in the month of October, 1896, under your instructions, and with it a map of the survey drawn to a scale of 1:3,000:

Royal River is a small river which flows through the town of Yarmouth to Casco Bay, and is navigable up to the falls, a distance of about 3 miles.

A base line was measured on the flats below the falls, and from this line points were taken and triangulations made which located the shore line. From these points lines were laid out crossing the river and on them soundings were taken with a pole.

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* Not printed.

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A bench mark was established on the western abutment of the bridge crossing the river near the falls, and is marked thus $\overline{V}$, the elevation of which is 10.27 above mean low tide, and was obtained by simultaneous readings of a tide gauge on Union wharf and the standard gauge in Portland, Me. There is at least 7 feet of water at mean low tide from Casco Bay to within one-third of a mile of Union wharf, with a width of about 150 feet; from this point to the wharf 6 feet of water at mean low tide can be carried, but the channel is narrow. A channel has been located on this map, and is shown shaded in red, 90 feet wide and 7 feet deep at mean low tide, beginning about 150 feet from Union wharf and extending down the river about 3,600 feet. The estimated quantity of material to be removed is 8,000 cubic yards, scow measurement, and the estimated cost is 50 cents per cubic yard. This, with 10 per cent added, would give a cost of $4,400 as the estimated cost of the improvement.

The material is gravel and clay. The only commerce at the present time is about 2,000 tons of coal, which is annually brought to this town.

Very respectfully, your obedient servant,

W. F. ROBINSON, *Assistant Engineer.*

Lieut. Col. A. N. DAMRELL,
Corps of Engineers, U. S. A.

A 32.

SURVEY OF EXETER RIVER, NEW HAMPSHIRE, FROM ITS MOUTH TO THE UPPER BRIDGE IN EXETER.

[Printed in House Doc. No. 41, Fifty-fifth Congress, first session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., May 3, 1897.

SIR: I have the honor to submit the accompanying report of April 23, 1897, by Lieut. Col. A. N. Damrell, Corps of Engineers, of the results of a survey of Exeter River, New Hampshire, from its mouth to the upper bridge in Exeter, made to comply with the requirements of the river and harbor act of June 3, 1896.

This river has heretofore been under improvement by the United States, the work being completed in 1881, and the project now presented by Colonel Damrell contemplates the restoration of the channel depths and widths up to Oxbow and thence up to Exeter to obtain 1 foot more (11 feet at mean high water) than before with the same width, with a turning basin at the upper end, 200 by 110 feet, estimated to cost $12,000.

It is the opinion of Colonel Damrell that the river is worthy of improvement, at least to the extent of restoring the old channel obtained in 1881.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF LIEUT. COL. A. N. DAMRELL, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Portland, Me., April 23, 1897.

GENERAL: I have the honor of submitting the following report upon the survey of the Exeter River, New Hampshire, from its mouth to the upper bridge in Exeter, provided for by the river and harbor act of June

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3, 1896, and assigned to my charge by letter of September 5, 1896, from the office of the Chief of Engineers.

A survey of this river was made in 1874, from its mouth in Great Bay up to the wharves at Exeter, 8.3 miles, and a project was submitted to obtain a towing channel with a minimum width of 40 feet and minimum depth from the mouth up to Oxbow (5.6 miles) of 12 feet at high water, and from Oxbow up to Exeter of 10 feet, to remove the bowlders all the way up between the 10-foot contours down to a depth of 10 feet below high tide, at an estimated cost of $34,000, the rise of the tide being 6.4 feet at the mouth and 6 feet at Exeter. The improvement was completed in 1881.

The survey made in October, 1896, shows that the improvement had been maintained reasonably well, the maximum fill being only 1 foot, and that the improvement needed now is to restore the channel depths and widths up to Oxbow, and from thence up to Exeter, to obtain 1 foot more than before with the same width, with a turning basin at the upper end, 200 by 110 feet, the estimated cost of which is $12,000.

The commerce on the river for 1896 is estimated at about 10,000 tons, about the same, apparently, as it was in 1874.

There is good reason to believe that the projected channel could be maintained at a very small annual cost.

I am of the opinion that the river is worthy of improvement, at least to the extent of restoring the old channel obtained in 1881.

A copy of the report of Mr. J. W. Walker, assistant engineer, by whom the survey was made, is appended hereto, and a tracing* of the map of the survey is forwarded in a separate roll.

Very respectfully, your obedient servant,

A. N. DAMRELL,
Lieut. Col., Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

REPORT OF MR. J. W. WALKER, ASSISTANT ENGINEER.

PORTLAND, ME., *January 13, 1897.*

COLONEL: I have the honor to submit a report of the survey of Exeter River, New Hampshire, made in compliance with your orders.

The survey is required by the river and harbor act of June 3, 1896, viz, "Survey of the Exeter River from its mouth to the upper bridge in Exeter."

I took charge of the survey October 6 and completed the field work October 28, 1896.

A survey of this river was made in 1874, and for purposes of comparison the present survey was well connected by means of old triangulation points. From Exeter to the Oxbow, distance 2 miles, and from Swamscot Bar to the toll bridge, distance 1 mile, a continuous transit line was run. Within these two sections of the river are the greatest obstructions to navigation, very closely covering the same area of shoal water existing prior to 1874. The shore line of the whole length of river remains unchanged from its location on the map of 1874; no indication of having been affected by floods or ice. A slight shoaling has taken place in "The Pocket" well inshore on the south side of channel. This is an advantage, as it lessens the cross section at this place, which is the maximum width above the toll bridge.

The plane of reference to which the soundings are reduced is the mean low water as established by the survey in 1874. The bench mark used is a brass bolt set in the coping stone of the retaining wall of the Swamscot Machine Company's wharf in the place indicated on the map. The top of the bolt is in reference 8.2 feet above mean low water. The mean rise and fall of tide in Great Bay is 6.4 feet, and at the wharves in Exeter 6 feet.

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*Not printed.

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The soundings were taken as follows: Upon the transit line angles were erected, generally right angles, and the lines marked by a signal on the transit line, and another far enough removed from the first to give a serviceable range across the river. The sounding boat was then rowed in exact range of the line across the river, and each sounding taken was located with the transit from some known point on the transit line. Soundings were taken with a pole divided accurately into feet and tenths.

The range lines for soundings were made about perpendicular to the thread of the current. By this method each line furnishes a correct cross section of the river, which may, if required, be constructed from the notes of the survey. At all places where dredging has been done the lines were kept from 50 to 100 feet apart. From the Oxbow to Swamscot Bar, and from the toll bridge to Great Bay, where the river remains in its natural condition, one line of soundings was taken parallel to and near the center of channel, soundings taken about 100 feet apart.

In 1881 the river was improved so as to give a depth of 6 feet at mean low water, with a channel width of 40 feet up to the Oxbow, 5.6 miles above the mouth of the river. Through and above the Oxbow the improvement gave a channel 4 feet deep at mean low water, with a channel width of 40 feet to Exeter wharves, 7.6 miles above the mouth of river. The survey shows a good channel 6 feet deep and 40 feet wide up to the Oxbow, excepting a slight shoal at Swamscot Bar and three dangerous bowlders at Perch Rocks. Through the Oxbow there is one bowlder and some filling in of the channel from the sides of the cut, the minimum depth found being 3.2 feet. From the Oxbow to Fernald's wharf there is a natural 4-foot channel. Above this wharf the channel decreases in depth, so that at present not over 3 feet can be carried to the wharves in the town of Exeter, distance 0.6 mile.

The material of which the bottom is composed at these shoal places is mud, gravel, and clay; also seven bowlders, which are located on the map, and will require blasting in removing.

The plan of improvement estimated upon and indicated on the map, after a consultation with yourself, is to obtain a channel not less than 40 feet wide and 6 feet deep at mean low water up to the Oxbow, and from the Oxbow to Exeter wharves a channel of the same width and 5 feet deep at mean low water, with a turning basin at Exeter wharves 200 by 110 feet.

ESTIMATE.

Proposed improvement of the river, following the channel in its entire length.

I.	Rock below toll bridge: Removal of bowlder No. VII, weighing 40 tons, at $8 per ton	$320
II.	The Pocket, off Ordways Point: Excavating a towing channel through this shoal 1,300 feet long, 40 feet wide, and 6 feet deep at mean low water requires dredging of 2,630 cubic yards of sand and gravel, at 40 cents per cubic yard	1,052
III.	Swamscot Bar: Excavating a towing channel through this bar 950 feet in length, 40 feet in width, and 6 feet deep at mean low water requires dredging of 1,420 cubic yards of sand and mud, at 40 cents per cubic yard	568
IV.	Perch Rock. Removal of bowlders Nos. IV, V, and VI, aggregating 60 tons, at $8 per ton	480
V.	The Oxbow. Removal of bowlder No. III weighing 20 tons, at $8 per ton	160
	Excavating a towing channel through the cut-off 300 feet long, 40 feet wide, and 5 feet deep at mean low water requires dredging of 900 cubic yards of clay, at 40 cents per cubic yard	360
VI.	Off Wheelwright Creek: Excavating a towing channel through this shoal 500 feet in length, 40 feet in width, and 5 feet deep at mean low water requires dredging 750 cubic yards of gravel, at 40 cents per cubic yard	300
VII.	Off Lyfords Point: Removal of bowlder No. II weighing 20 tons, at $8 per ton	160
VIII.	From Jades Hill Point to Fernald's wharf: Excavating towing channel 2,000 feet in length, 40 feet in width, and 5 feet deep at mean low water requires the removal by dredging of 3,000 cubic yards of mud and gravel, at 40 cents per cubic yard	1,200
IX.	Off Fernald's wharf: Removal of bowlders weighing 15 tons, at $8 per ton	120
X.	From Fernald's wharf to Gilman's wharf: Excavating towing channel 2,000 feet long, 40 feet wide, and 5 feet deep at mean low water requires the removal by dredging of 7,400 cubic yards of mud and gravel, at 40 cents per cubic yard	2,960

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XI. Turning basin:

Excavating turning basin 200 feet in length, 110 feet in width, and 5 feet deep at mean low water requires the removal by dredging of 3,260 cubic yards of hard pan, at $1 per cubic yard	$3,260
Estimate based on "situ" measurement	10,940
As the above estimate is made for measurement "in situ," 20 per cent may safely be added for scow measurement	2,188
Estimate for scow measurement	13,128
Contingencies, 10 per cent	1,312
Total	14,440

It is believed the increased advantages this improvement offers to navigation justify the expenditure of the above estimate. A statement of the commercial statistics of the river for the year 1896 is submitted herewith.

Very respectfully, your obedient servant,

J. W. WALKER, *Assistant Engineer.*

Lieut. Col. A. N. DAMRELL,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS OF EXETER RIVER, NEW HAMPSHIRE, FOR THE YEAR 1896.

	Tons.
Coal	9,010
Stone, building	500
Lumber	200
Wood, cord	256
General merchandise	200

Portland, Me., January 13, 1897.

Respectfully submitted.

J. W. WALKER, *Assistant Engineer.*

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APPENDIX B.

IMPROVEMENT OF RIVERS AND HARBORS IN EASTERN MASSACHUSETTS.

REPORT OF LIEUT. COL. S. M. MANSFIELD, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1897, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Newburyport Harbor, Massachusetts.
2. Merrimac River, Massachusetts.
3. Powow River, Massachusetts.
4. Essex River, Massachusetts.
5. Harbor of Refuge, Sandy Bay, Cape Ann, Massachusetts.
6. Gloucester Harbor, Massachusetts.
7. Manchester Harbor, Massachusetts.
8. Lynn Harbor, Massachusetts.
9. Mystic and Malden rivers, Massachusetts.
10. Boston Harbor, Massachusetts.
11. Town River, Massachusetts.
12. Weymouth River, Massachusetts.
13. Scituate Harbor, Massachusetts.
14. Plymouth Harbor, Massachusetts.
15. Provincetown Harbor, Massachusetts.
16. Chatham Harbor, Massachusetts.
17. Removing sunken vessels or craft obstructing or endangering navigation.

EXAMINATIONS.

18. Duxbury Harbor, Massachusetts.
19. Duxbury Beach, Massachusetts.
20. Gurnet and other rocks, Plymouth Harbor, Massachusetts.
21. Approaches to the Cape Cod Ship Canal, Massachusetts.

SURVEYS.

22. Merrimac River, Massachusetts.
23. Manchester Harbor, Massachusetts.
24. Manchester Harbor, Massachusetts.
25. Marblehead Harbor, Massachusetts.
26. Lynn Harbor, Massachusetts.
27. Weymouth (Back) River, Massachusetts.
28. Neponset River, Massachusetts.
29. Plymouth Harbor, Massachusetts.
30. Provincetown Harbor, Massachusetts.

HARBOR LINES.

31. Charles River at Cambridge, Mass.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., July 17, 1897.

GENERAL: I have the honor to transmit herewith annual reports for the works of river and harbor improvements in my charge, for the fiscal year ending June 30, 1897.

Very respectfully, your obedient servant,

S. M. MANSFIELD,
Lieut. Col., Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

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B 1.

IMPROVEMENT OF NEWBURYPORT HARBOR, MASSACHUSETTS.

Newburyport, Mass., is situated about 2½ miles from the Atlantic Ocean, on the south bank of the Merrimac River.

The river empties into the Atlantic Ocean midway between Cape Ann and Portsmouth, or about 30 miles a little east of north from Boston in a direct line.

The outlet of the river between Plum Island and Salisbury Point is 1,000 feet wide and 30 feet deep at mean low water. At a distance of nearly a mile outside lies a sandy bar, thrown up by wave action, through which, previous to the improvement, a channel, variable in position and depth, was maintained by the current of the river, increased by the tidal flow in a large interior basin through a mean range of tides of 7.7 feet.

For 1,000 feet outward from the gorge toward the crest of the bar the current was able to maintain a channel of navigable width and 18 feet deep at mean low water, and for a farther distance of 1,500 feet a channel 12 feet deep. From the 18-foot contour line on the inside to the same on the outside the distance was 4,000 feet, and between the 12-foot contours the distance was 3,000 feet.

The depth on the crest of the bar was generally less than 7 feet at mean low water.

The object of the improvement is to create through the outer bar a channel 1,000 feet wide and at least 17 feet deep at mean low water, so that vessels may cross the bar and find a harbor at any stage of the tide with as great draft as can reach Newburyport by the river at high tide.

The project submitted September 18, 1880, proposed two converging rubblestone jetties and the protection of the beach in their vicinity.

The converging portion of the north jetty was to be about 2,900 feet long; of the south jetty about 1,500 feet.

The outer ends of the jetties were to be about 1,000 feet apart, and to be extended parallel to the axis of the channel if found necessary.

The estimated cost of this project for shore protection and the converging portions of the jetties was $240,000.

This estimate was increased in 1881 to $365,000.

The project was modified in 1882 so as to provide for the partial closing of Plum Island Basin with a timber dike about 800 feet long and 5½ feet above mean low water. The location and details of construction of the dike are given in the report of 1883.

The direction of the south jetty and the character of the shore protection was modified in 1883.

Both jetties are 15 feet wide on top, which is in a plane 12 feet above mean low water, and have slopes of 1 on 2 on the sea side and 1 on 1 on the shore side.

A map showing the location of the jetties is published in the Annual Report of the Chief of Engineers for 1885.

The total appropriations to date have been $313,500.

The expenditures to June 30, 1896, were $295,957.29.

On June 30, 1896, the condition of the improvement was as follows:

The north jetty was 2,705 feet long, fully completed; the south jetty was completed for 1,540 feet, and its shore end was strengthened by a sand catch; the dike was completed so far as was prudent for its safety; it was 817 feet long, 5½ feet high above mean low water, except that

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near its center a weir had been left open, 150 feet long, its sill 2 feet above mean low water.

On October 12, 1896, a contract was entered into with the Rockport, Pigeon Hill, and Cape Ann granite companies to deposit 13,000 tons of stone in the south jetty, at $1.03 per ton.

Operations were commenced under this contract May 25, 1897, and 476 tons were deposited during the fiscal year. These operations have resulted in no material change, and the condition of the improvement at the date of this report is practically the same as on June 30, 1896.

On March 24, 1897, a revised estimate of cost of the project of improvement was submitted.

The original project had been completed well within the estimate of $365,000, submitted in 1881, and increased to $375,000 in 1884, but while the probable necessity of extending the jetties parallel to the axis of the channel was recognized in the original project, the estimate was not made to include cost of such extension.

The total expenditures to June 30, 1896, were $295,957.29, leaving to the credit of the work under the project $79,042.71.

The north jetty had been completed for 2,705 feet of the proposed 2,900 feet length; the south jetty had been completed for 1,540 feet, and the length estimated for was about 1,500 feet, and the dike was practically completed.

The revised estimate submitted was as follows:

To complete both jetties with extensions parallel for 1,000 feet will cost, viz:

North jetty, 100,800 tons stone, at $1.50 per ton	$151,200.00
South jetty, 82,588 tons stone, at $1.50 per ton	123,882.00
	275,082.00
Engineering and contingencies	27,508.20
	302,590.20
To complete dike	1,000.00
	303,590.20
Credit under old estimate	79,042.71
Increase in estimate	224,547.49

A survey of the bar was made in June, 1897, and by comparison with the last survey made in 1895 it is found that the outside contours of the bar have not materially altered, but that the extension of the south jetty has made its influence felt in a division of the scouring effect of the current on the bar.

The channel shown by the survey in 1895, extending to the southward, along the shore of Plum Island, and which had 13 feet available depth, has shoaled to about 10.5 feet depth, and another channel of about equally as great width and depth extends directly to the eastward through the bar in the location proposed by the project of improvement.

It is expected that the extension of the south jetty, under the existing contract, will further develop the eastward channel by deflecting the ebb currents more from the channel along the shore of Plum Island.

The advantage to be derived from the completion of the project is the deepening and widening of the channel across the bar, thereby affording a harbor of refuge on the inside of Salisbury Beach and giving easy

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access at high tide to the wharves at Newburyport for vessels drawing 17 feet approximately.

This work is located in the collection district of Newburyport, Mass., of which Newburyport is the port of entry. The nearest light-house is on Plum Island, at the entrance of the harbor.

Money statement.

July 1, 1896, balance unexpended		$17,542.71
June 30, 1897, amount expended during fiscal year		999.06
July 1, 1897, balance unexpended		16,543.65
July 1, 1897, outstanding liabilities	$528.54	
July 1, 1897, amount covered by uncompleted contracts	12,899.72	
		13,428.26
July 1, 1897, balance available		3,115.39
Amount (estimated) required for completion of existing project		286,047.49
Amount that can be profitably expended in fiscal year ending June 30, 1899		286,047.49
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

The dates and amounts of appropriations for this work are as follows:

Act of—		Act of—	
June 14, 1880	$50,000	September 19, 1890	$25,000
March 3, 1881	40,000	July 13, 1892	20,000
August 2, 1882	40,000	August 17, 1894	20,000
July 5, 1884	40,000	June 3, 1896	16,000
August 5, 1886	37,500		
August 11, 1888	25,000	Total	313,500

Abstract of proposals for furnishing rubblestone in the south jetty at Newburyport Harbor, Massachusetts, opened September 26, 1896, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price per ton of 2,000 pounds.	Total number of tons.
1	John L. Grim, Philadelphia, Pa	$1.24	12,903
2	Rockport Granite Co., Rockport, Mass Pigeon Hill Granite Co., Rockport, Mass. *a* Cape Ann Granite Co., Boston, Mass	1.03	15,533
3	George Willett Andrews, Biddeford, Me	1.21	13,223
4	Lanesville Granite Co., Lanesville, Mass	1.24½	12,851

a Lowest bidder.

The contract was awarded to the Rockport, Pigeon Hill, and Cape Ann Granite companies, with the approval of the Chief of Engineers.

LIST OF CONTRACTS IN FORCE JUNE 30, 1897.

Contract with the Rockport Granite Company, Pigeon Hill Granite Company, and Cape Ann Granite Company, all of Rockport, Mass., to furnish 13,000 tons of rubblestone in the south jetty, at $1.03 per ton of 2,000 pounds.

Date of contract, October 12, 1896; approved October 31, 1896; time of commencement, April 1, 1897; time of completion, June 30, 1898.

The accompanying commercial statistics have been furnished by the collector of customs of Newburyport, Mass.

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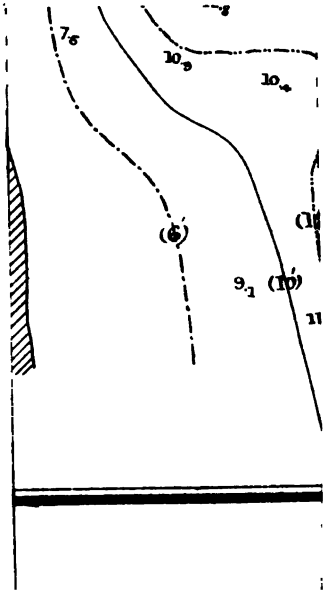

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COMMERCIAL STATISTICS.

Amount of revenue collected, 1895, $423.15; 1896, none; 1897, $398.78.

Shipping.	1895.		1896.		1897.	
	No.	Tons.	No.	Tons.	No.	Tons.
Entrances:						
Foreign	4	368	.....	.....	3	258
Domestic	.....	.....	230	.....	300	100,000
Clearances:						
Foreign	8	1,306	11	.....	3	258

Imported.	1895.	1896.	1897.
Coal.....tons..	643	164,700	158,270
Lumber.....feet..	.....	.....	110,000
Molasses:			
Puncheons	.....	.....	163
Tierces	.....	.....	48
Shingles.....number..	.....	.....	630,000

Mostly three-masted schooners, ranging from 8 to 15 feet draft, frequent the harbor.

B 2.

IMPROVEMENT OF MERRIMAC RIVER, MASSACHUSETTS.

The mouth of the Merrimac River is 15 miles northwest from Cape Ann, Massachusetts. Tide water extends up it a distance of 21½ miles, or to the foot of the Upper Falls, 1½ miles above Haverhill, Mass.

Seven incorporated cities and the largest mills in New England are directly interested in this improvement.

Before improvement the channel was narrow and crooked, and much obstructed by ledges, bowlders, and shoals.

At mean low water vessels drawing not to exceed 7 feet could enter the river and proceed to South Amesbury, 9 miles from the mouth. The sea bar at the mouth of the river has been improved under specific appropriations for the improvement of Newburyport Harbor, while many sunken rocks and wrecks of piers and vessels lying inside the bar have been removed by general appropriations for the improvement of the river.

The object of the improvement is to widen, straighten, and deepen the natural channel of the river from the bar to the head of tide water. The rise or fall of the tide at the mouth is 7.7 feet; at Haverhill Bridge, 4.62 feet.

The project originally adopted, in 1870, proposed to remove obstructions from the Upper and Lower Mitchells falls, and to remove the Gangway Rock and the Boilers, in Newburyport Harbor.

The cost was estimated to be $69,025.

The project was modified in 1874 so as to include the removal of rocks in and near the draw of the bridge at Deer Island, 2 miles above Newburyport, and at Rock Bridge and at Little Curriers Shoals, East Haverhill, so that the channel should have the following depths at ordinary high-water stages of the river: From the mouth to Deer Island Bridge, 5 miles, 16½ feet; thence to Haverhill Bridge, 12½ miles, 12 feet; thence to the foot of Mitchells Falls, Hazeltine Rapids, 1½ miles, 10 feet; thence through Mitchells Falls to the head of the Upper

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Fall, 2½ miles, not less than 4½ feet when the mill water at Lawrence is running.

This revised project was estimated to cost $147,000.

The total appropriations to date are $247,366.72.

The expenditures to June 30, 1896, were $242,366.72.

The excess of expenditure over the estimate is due to the removal of rocks and other obstructions that were unknown and cost of removal not included in the estimate, and by the expense of necessary surveys and examinations not provided for in the estimate.

On June 30, 1894, the project for the improvement of the river was completed.

The river and harbor act of June 3, 1896, appropriated $5,000 for the removal of "certain rocks below Rock Bridge."

On October 15, 1896, a contract was entered into with the Eastern Dredging Company to dredge 800 cubic yards, more or less, of bowlders, at $4 per cubic yard, from the channel in the vicinity of Rock Bridge.

Operations under this contract were commenced in November and completed in December, 1896, and 855 cubic yards were removed from the channel.

The river and harbor act of June 3, 1896, also ordered that an estimate be made "of the cost of improving the Merrimac River, Massachusetts, by dredging the channel thereof between Newburyport and Haverhill of the width of 150 feet and of the depth of 7 feet at mean low water, provided the estimate can be furnished from surveys already made."

This estimate was submitted to the Department May 5, 1897, and was published as House Doc. No. 52, Fifty-fifth Congress, first session. It was based on the survey of the river made in 1894–95, the report and plan of which were submitted January 15, 1896, and were published as House Doc. No. 168, Fifty-fourth Congress, first session.

No other operations were in progress during the fiscal year.

This work is located in the collection district of Newburyport, Mass., of which Newburyport is the nearest port of entry. The nearest light-houses are the Plum Island lights and the Newburyport Upper Harbor lights.

No increase of the tonnage of the river is apparent since the improvement was commenced, and no new lines of water transportation have been established.

Money statement.

July 1, 1896, balance unexpended	$5,000.00
June 30, 1897, amount expended during fiscal year	3,693.95
July 1, 1897, balance unexpended	1,306.05

The dates and amounts of appropriations for this work are as follows:

Act of—		Act of—	
May 23, 1828	$32,100.00	June 18, 1878	$10,000.00
April 2, 1830	3,506.72	March 3, 1879	5,000.00
March 2, 1831	16,000.00	June 14, 1880	12,000.00
March 2, 1833	4,900.00	March 3, 1881	9,000.00
June 28, 1834	3,860.00	August 2, 1882	9,000.00
July 11, 1870	25,000.00	July 5, 1884	3,500.00
March 3, 1871	25,000.00	September 19, 1890	10,000.00
June 10, 1872	25,000.00	July 13, 1892	1,500.00
March 3, 1873	25,000.00	June 3, 1896	5,000.00
June 23, 1874	10,000.00		
March 3, 1875	12,000.00	Total	247,366.72

Appropriations made since 1870 have been expended on the approved project of that date and its modifications.

Commercial statistics are included in statement for Newburyport Harbor.

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Abstract of proposal for dredging in Merrimac River, Massachusetts, opened September 29, 1896, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid per cubic yard.		Total yards that can be dredged.
		For dredging.	Bowlders over 6 tons each.	
1	Eastern Dredging Co., Boston, Mass	$4	$10	1,250

The contract was awarded to the Eastern Dredging Company, with the approval of the Chief of Engineers.

B 3.

IMPROVEMENT OF POWOW RIVER, MASSACHUSETTS.

Powow River is a tributary of the Merrimac River, into which it enters from the north about 3½ miles above Newburyport.

From its mouth tide water extends 9,600 feet in a narrow, crooked channel, not navigable at low water.

The plan for improvement, submitted January 24, 1885, proposed to dredge a channel 9,600 feet long, 60 feet wide, and 12 feet deep at mean high water, at an estimated cost of $77,000.

The mean rise or fall of tide is 6.7 feet.

The total appropriations to date have been $39,000.

The amount expended to June 30, 1896, was $5,125.83.

At that date operations were in progress under a contract, dated October 15, 1894, with Mr. Augustus R. Wright to dredge 64,000 cubic yards, at 39 cents per yard, from the channel; but as only 23,209 cubic yards had been dredged, no appreciable benefit to navigation had resulted.

During the fiscal year operations were continued under the contract of October 15, 1894, and the contract was satisfactorily completed October 31, 1896, resulting in a channel 12 feet deep at mean high water, at least 30 feet wide, and of full projected length.

On October 15, 1896, a contract was entered into with the Eastern Dredging Company to dredge 25,000 cubic yards of material from the channel, at 39 cents per yard.

Operations were commenced under this contract in October, 1896, and were completed in May, 1897, by the removal of 26,795 cubic yards.

At the date of this report the channel is 12 feet deep at mean high water, 45 feet wide for a length of 3,252 feet, and at least 30 feet wide for its entire projected length.

On March 24, 1897, a revised estimate of cost of the improvement was submitted in accordance with Department letter 16423, dated August 7, 1896.

This increased estimate was found necessary owing to the difficulty encountered in disposing of dredged material.

The revised estimate was as follows:

Amount expended in excavating 90,895 cubic yards	$39,000
For excavating remaining 139,105 cubic yards, at 40 cents per cubic yard	55,642
Engineering and contingencies	5,358
	100,000

To complete the improvement will require an appropriation of $61,000, all of which could be expended to advantage during the year ending June 30, 1899.

This work is located in the collection district of Newburyport, Mass., of which Newburyport is the nearest port of entry. The nearest light-houses are the Newburyport Upper Harbor lights.

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No new lines of water transportation have been established.

Money statement.

July 1, 1896, balance unexpended	$33,874.17
June 30, 1897, amount expended during fiscal year	33,750.24
July 1, 1897, balance unexpended	123.93
Amount (estimated) required for completion of existing project	61,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	61,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

The total appropriations for this work are as follows:

Act of—		Act of—	
August 11, 1888	$3,000	June 3, 1896	$12,000
September 19, 1890	5,000		
July 13, 1892	4,000	Total	39,000
August 17, 1894	15,000		

Abstract of proposals for dredging in Powow River, Massachusetts, opened September 29, 1896, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price per cubic yard.		Total yards that can be dredged.
		For dredging.	Bowlders over 3 tons each.	
1	Augustus B. Martin, Boston, Mass.	$0.45	$5.00	26,666
2	Eastern Dredging Co., Boston, Mass.a	.39	5.00	30,769

a Lowest bid.

The contract was awarded to the Eastern Dredging Company, with the approval of the Chief of Engineers.

No contracts are in force at date of this report.

Commercial statistics are included in the statement for Newburyport Harbor.

B 4.

IMPROVEMENT OF ESSEX RIVER, MASSACHUSETTS.

Essex River winds between marshy banks for 3½ miles from the head of navigation, at the village of Essex, to its mouth, which forms a harbor of refuge for light-draft vessels, about 3 miles to the southeastward of the entrance to Ipswich River, Massachusetts. The channel of the river is crooked and obstructed by sand bars and bowlders.

The project for its improvement was submitted May 15, 1891. It proposed to widen and deepen the upper 12,000 feet of the natural channel of the river, so that 4 feet at mean low water could be carried to the head of navigation in a channel 60 feet wide, at a cost, as estimated, of $25,000.

The mean rise or fall of the tide is 8.8 feet.

The total appropriations to date have been $15,000.

The expenditures to June 30, 1896, were $9,711.39.

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At that date the channel had been dredged to the full projected depth and at least 25 feet wide to the drawbridge in Essex.

On May 8, 1897, a project was submitted for the expenditure of $5,000, made available by the river and harbor act of June 3, 1896.

This project proposed to dredge the channel of full width and depth from the drawbridge in Essex down the river as far as the available funds would permit.

On June 28, 1897, proposals were received for the work under this project and submitted to the Department.

At the date of this report the improvement is in the same condition as on June 30, 1896.

To complete the improvement will require an appropriation of $10,000, all of which could be expended to advantage during the fiscal year ending June 30, 1898.

Essex River is in the collection district of Gloucester, Mass., of which Gloucester is the port of entry. The nearest light-house is Annisquam light, 2 miles east of the mouth of the river.

Money statement.

July 1, 1896, balance unexpended	$5,288.61
July 1, 1897, balance unexpended	5,288.61
July 1, 1897, outstanding liabilities	19.00
July 1, 1897, balance available	5,269.61
Amount (estimated) required for completion of existing project	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

Appropriations have been made for this work, viz:

Act of—	
July 13, 1892	$5,000
August 17, 1894	5,000
June 3, 1896	5,000
Total	15,000

Abstract of proposals for dredging in Essex River, Massachusetts, opened June 28, 1897, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price per cubic yard.		Total yards that can be dredged.
		For dredging.	For removal of bowlders over 6 tons each.	
1	Eastern Dredging Co., Boston, Mass.[a]	$0.31	$10.00	14,516
2	Augustus B. Martin, Boston, Mass	.31½	8.00	14,285

[a] Lowest bid.

The contract was awarded to the Eastern Dredging Company, with the approval of the Chief of Engineers.

Commercial statistics are included in the statement for Gloucester Harbor, Massachusetts.

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B 5.

IMPROVEMENT OF HARBOR OF REFUGE, SANDY BAY, CAPE ANN, MASSACHUSETTS.

Sandy Bay is situated at the northeastern extremity of the promontory of Cape Ann, which forms the northern limit of Massachusetts Bay. Its shore lines form a little less than a right angle, and their directions are nearly north and south and east and west. The rocky island of Straitsmouth forms the eastern extremity of one shore line, and the steep headland of Andrews Point the northern end of the other. Following the line of the proposed breakwater, the bay is 2¾ miles wide by 2 miles in area, approximately.

The bay on the land side is perfectly protected by steep, high hills, but it fronts the northeast and is open to the full force of the violent northerly and easterly gales of this coast.

The great seas of the ocean are broken, however, in a degree, by the sunken rocky ledges called Avery Ledge, the Dry and Little Salvages, the Flat Ground, and Abners Ledge, which are directly at the mouth of the bay. Inside these entrance ledges the bay is entirely unobstructed and has an average depth of 50 feet at mean low water.

The original project for improvement was submitted in 1884. It proposed a continuous breakwater 9,000 feet long, divided into two branches. One starts at Averys Ledge and runs in a direction a little west of north to Abners Ledge, a distance of 3,600 feet; the other extends 5,420 feet from Abners Ledge in a northwesterly direction, and terminates at the 84-foot contour off Andrews Point.

The substructure was to consist of a mound of rubblestone to a grade of 22 feet below mean low water, 40 feet wide on top, to be surmounted by a masonry wall.

The axis of the proposed breakwater is approximately at the inner edge of the ledges, at the entrance of the bay, and about 1 mile inside the Salvages and Flat Ground, which receive the first shock of easterly storm waves.

The southern entrance to the proposed harbor lies between Straitsmouth Island and Averys Ledge, and is to be 1,800 feet wide and at least 30 feet deep. The northern entrance, near Andrews Point, is 2,700 feet wide and 80 feet deep. They are so located with reference to each other that vessels can enter and leave the harbor with any wind.

The harbor formed by the breakwater covers an anchorage of 1,377 acres, in which the depth exceeds 24 feet at mean low water.

On March 2, 1892, the project was modified by a report of the special board of engineers constituted for that purpose, and proposes to construct the entire breakwater of rubblestone with the following section: On the seaside, from the bottom to 15 feet below mean low water, a slope of 1 on 1½; thence to mean low water, 1 on 3; thence to 18 feet above mean low water, 1 on 1; the width on the crest, 20 feet, and the rear slope, 1 on 0.73 to mean low water; thence to the bottom, 1 on 1.

A plan of the bay showing the proposed breakwater was published in the Annual Report of the Chief of Engineers for 1892, page 564.

The estimated cost of the improvement is $5,000,000, to which must be added $2,500,000 for buoyage, lighting, and defense of the harbor.

The total appropriations to date have been $900,000.

The expenditures to June 30, 1896, were $641,696.62.

At that date 600 feet of the breakwater were completed, 600 feet

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additional were completed of full section up to low water and 3,400 feet more were built up to 22 feet below low water, 40 feet wide on top.

Seven hundred and seventy-five thousand seven hundred and seventy-two tons of small stone and 13,488 tons of large stone had been deposited in the breakwater in its construction.

Operations were in progress under a contract with the Cape Ann Granite Company to deposit 240,000 tons of small stone in the breakwater.

These operations were continued during the fiscal year, and 115,893 tons were deposited under the contract.

On October 12, 1896, a contract was entered into with the Rockport, Pigeon Hill, and Cape Ann granite companies to deposit 200,000 tons of small stone in the breakwater.

Operations were commenced in November, 1896, and during the year 31,667 tons of stone was deposited under this contract.

A total of 923,332 tons of small stone and 13,488 tons of large stone have been deposited in the breakwater to date, and its condition is as follows: 600 running feet are fully completed; 1,200 feet additional are practically completed to low water, and for a further length of 2,800 feet the mound is at least 40 feet wide on top and up to 22 feet below low water.

The completed portion of the breakwater is in fair order, although some settlement is apparent and additional stone will be needed to bring it to grade.

To complete the project will cost $4,100,000.

During the fiscal year ending June 30, 1899, $500,000 could be expended to advantage.

The prospective benefits to commerce and navigation by the construction of this harbor of refuge are increased safety to life and property, and a consequent reduction in freight and insurance.

Sandy Bay is situated in the collection district of Gloucester, Mass., of which Gloucester is the port of entry. The nearest light-house is Straitsmouth Light, at the southern entrance of the bay.

Money statement.

July 1, 1896, balance unexpended		$258,303.38
June 30, 1897, amount expended during fiscal year		81,788.63
July 1, 1897, balance unexpended		176,514.75
July 1, 1897, outstanding liabilities	$25,335.59	
July 1, 1897, amount covered by uncompleted contracts	131,113.58	
		156,449.17
July 1, 1897, balance available		20,065.58
Amount (estimated) required for completion of existing project		4,100,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		500,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

The dates and amounts of the appropriations for this work are as follows:

Act of—		Act of—	
July 5, 1884	$100,000	August 17, 1894	$150,000
August 5, 1886	100,000	June 3, 1896	150,000
August 11, 1888	100,000		
September 19, 1890	150,000	Total	900,000
July 13, 1892	150,000		

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Abstract of proposals for furnishing rubblestone in the breakwater at Sandy Bay, Massachusetts, opened October 4, 1894, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid per ton of 2,000 pounds.	Total tons can be delivered.
		Cents.	
1	Cape Ann Granite Co., Boston, Mass. *a*	59.7	251,256
2	Pigeon Hill Granite Co., Rockport, Mass	69	217,391
3	George Willett Andrews, Biddeford, Me	81	185,185
4	Hughes Bros. & Banga, Syracuse, N. Y	77	194,805
5	Rockport Granite Co., Rockport, Mass	61	245,901

a Lowest bid.

The contract was awarded to the Cape Ann Granite Company, with the approval of the Chief of Engineers.

Abstract of proposals for furnishing rubblestone in the breakwater at Sandy Bay, Massachusetts, opened September 26, 1896, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price per ton of 2,000 pounds.	Total number of tons.
		Cents.	
1	John L. Grim, Philadelphia, Pa	84.5	177,514
2	Rockport Granite Co., Rockport, Mass Pigeon Hill Granite Co., Rockport, Mass. *a* Cape Ann Granite Co., Boston, Mass	66.9	224,215
3	Lanesville Granite Co., Lanesville, Mass	81.2	184,729

a Lowest bid.

The contract was awarded to the Rockport, Pigeon Hill, and Cape Ann Granite companies, with the approval of the Chief of Engineers.

LIST OF CONTRACTS IN FORCE AT DATE OF THIS REPORT.

Contract dated October 15, 1894: Contractors, Cape Ann Granite Company; to furnish 240,000 tons, more or less, of rubblestone in breakwater, at 59.7 cents per ton.

Date of approval, October 23, 1894; to be commenced December 1, 1894; to be completed December 31, 1896; extended to December 1, 1897.

Contract dated October 12, 1896: Contractors, Rockport, Pigeon Hill, and Cape Ann Granite companies; to furnish 200,000 tons, more or less, of rubblestone in breakwater, at 66.9 cents per ton.

Date of approval, October 31, 1896; to be commenced November 12, 1896; to be completed December 31, 1898.

The accompanying commercial statistics for the fiscal year ending June 30, 1897, have been furnished by Mr. Charles S. Rogers, of Rockport, Mass.:

COMMERCIAL STATISTICS.

Articles.	1895.	1896.	1897.
Shipped:			
Stone ..... tons..	300,000	430,000	475,000
Received:			
Coal ..... tons..	9,000	8,500	10,400
Wood ..... cords..	600	400	350
Lumber ..... feet..	575,000	750,000	830,000
Fish ..... pounds..	2,850,000	2,500,000	2,525,000
Mackerel ..... barrels..	700	300	275
Fish sounds ..... pounds..	275,000	276,000	279,000
Lobsters ..... barrels..	700	750	400
Cod oil ..... gallons..	9,000	3,000	4,500
Medicine oil ..... do....	4,000	4,000	5,000
Salt ..... hogsheads..	525	550	575
Herring ..... barrels..	.....	500	450
Salt fish ..... pounds..	.....	600,000	608,000

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B 6.

IMPROVEMENT OF HARBOR AT GLOUCESTER, MASSACHUSETTS.

Gloucester Harbor is an important center for the fishing fleet of New England, about 20 miles north of Boston. Its inner harbor was originally obstructed by sunken rocks and shoals, and the approaches to the wharves were shallow, varying from 1 to 12 feet. The outer harbor was open to all southerly gales.

The first project for its improvement was submitted January 20, 1871, and proposed to build a breakwater from Eastern Point to Round Rock Shoal and to clear the harbor of sunken rocks.

The present approved project was submitted in 1887. (Annual Report for 1887, Part I, p. 500.) It proposed to remove from the inner harbor obstructing rocks and shoals, giving in front of the wharves, as far as Pew's wharf, 15 feet depth at low water and 10 feet in Harbor Cove, and to build a breakwater from Eastern Point to Round Rock Shoal.

The total appropriations to date have been $154,000.

The expenditures to June 30, 1896, were $107,473.93.

At that date the dredging proposed under the project had been completed.

The construction of the breakwater had been commenced, and 52,598 tons of rubblestone had been deposited in its substructure, completing it up to low water for a length of 850 feet.

A contract was in force with the Rockport Granite Company, dated October 16, 1894, for the deposit of 57,000 tons of rubblestone in the breakwater.

Operations were continued during the fiscal year under the contract dated October 16, 1894, and it was satisfactorily completed July 30, 1896; 4,202 tons of stone was deposited after June 30, 1896, making a total of 56,800 tons deposited under the contract.

On October 12, 1896, a contract was entered into with the Rockport Granite Company, Pigeon Hill Granite Company, and Cape Ann Granite Company to deposit 34,000 tons of stone in the breakwater.

Operations under this contract were commenced November 21, 1896, and during the year 17,668 tons of stone was deposited, and at the date of this report the breakwater is completed up to low water for a total length of 1,100 feet.

The river and harbor act of June 3, 1896, appropriated $2,000, to be expended in removing from Gloucester Harbor a pinnacle rock in the outer harbor, a rock called Elisha's Rock in the inner harbor, and a rock near the ferry landing at Rock's Neck in the inner harbor.

A survey of these rocks was made in November, 1896, and on May 5, 1897, a project was submitted proposing to remove the pinnacle rock in the outer harbor to a depth of 16 feet at mean low water, and the rocks off the Ferry Landing to the level of the surrounding bottom, aggregating 105 cubic yards.

This project was approved by the Secretary of War May 11, 1897.

On June 28, 1897, bids were received and opened, and it was recommended that the lowest bid, that of Hiram W. Phillips, $15.85, be accepted for the removal of these rocks under the project.

No other operations were in progress under this project during the fiscal year.

No benefit has resulted from the construction of the breakwater, as no sheltered anchorage has as yet been obtained.

To complete the improvement will require an appropriation of $678,000, of which $200,000 could be expended to advantage during the fiscal year ending June 30, 1898.

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The prospective advantage to commerce by the completion of the improvement is more safe anchorage for vessels seeking protection from southerly gales.

Gloucester Harbor is in the collection district of Gloucester, Mass., of which Gloucester is the port of entry. The nearest light-houses are Ten Pound Light, in the harbor, and Eastern Point Light, at its entrance.

Money statement.

July 1, 1896, balance unexpended		$46,526.07
July 30, 1897, amount expended during fiscal year		26,911.75
July 1, 1897, balance unexpended		19,614.32
July 1, 1897, outstanding liabilities	$1,991.32	
July 1, 1897, amount covered by uncompleted contracts	13,555.56	
		15,546.88
July 1, 1897, balance available		4,067.44
Amount (estimated) required for completion of existing project		678,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		200,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

The dates and amounts of the appropriations for this work are as follows:

Act of—		Act of—	
June 10, 1872	$10,000	August 17, 1894	$40,000
August 5, 1886	5,000	June 3, 1896	34,000
August 11, 1888	10,000		
September 19, 1890	15,000	Total	154,000
July 13, 1892	40,000		

Abstract of proposals for the delivery of rubblestone in breakwater at Gloucester, Mass., opened October 4, 1894, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid per ton of 2,000 pounds.	Total tons can be delivered.
1	Pigeon Hill Granite Co., Rockport, Mass	$0.94	38,297
2	Cape Ann Granite Co., Boston, Mass	.89	40,449
3	Joseph H. White, Boston, Mass	1.09	33,027
4	Seth Perkins and J. E. White, Boston, Mass	.97	37,113
5	Rockport Granite Co., Rockport, Mass. *a*	.87	41,379
6	George Willett Andrews, Biddeford, Me	1.07	33,644
7	Hughes Bros. & Bangs, Syracuse, N. Y	1.42	25,352
8	Lanesville Granite Co., Rockport, Mass	.99½	36,180

a Lowest bid.

The contract was awarded to the Rockport Granite Company, with the approval of the Chief of Engineers.

Abstract of proposals for furnishing rubblestone in breakwater at Gloucester, Mass., opened September 26, 1896, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price per ton of 2,000 pounds.	Total number of tons.
1	John L. Grim, Philadelphia, Pa	$0.92	34,782
a 2	Rockport Granite Co., Rockport, Mass. Pigeon Hill Granite Co., Rockport, Mass. Cape Ann Granite Co., Boston, Mass.	.83	38,554
3	Lanesville Granite Co., Lanesville, Mass	.90	35,555

a Lowest bid.

The contract was awarded to the Rockport, Pigeon Hill, and Cape Ann Granite companies, with the approval of the Chief of Engineers.

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Abstract of proposals for the removal of ledges from Gloucester Harbor, Massachusetts, opened June 28, 1897, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price per cubic yard.	Total Amount.
1	Cornelius Van Anglen, East Boston, Mass.	$19.00	$1,995.00
2	John Olson	15.93	1,672.65
2	George W. Townsend, Boston, Mass.	15.93	1,672.65
3	Hiram W. Phillips, Quincy, Mass. a	15.85	1,664.25

a Lowest bid.

The contract was awarded to Hiram W. Phillips, with the approval of the Chief of Engineers.

LIST OF CONTRACTS IN FORCE JUNE 30, 1897.

Contract dated October 12, 1896—contractors, Rockport, Pigeon Hill, and Cape Ann Granite companies—to furnish and deposit in the breakwater at Gloucester 34,000 tons, more or less, of rubblestone, at 83 cents per ton of 2,000 pounds.

Date of approval, October 31, 1896; to be commenced November 12, 1896; to be completed June 30, 1898.

The accompanying commercial statistics have been furnished by the collector of customs at Gloucester, Mass.

COMMERCIAL STATISTICS.

Amount of revenue collected, 1895, $8,660; 1896, $1,150; 1897, $8,000.

Shipping.	1895.		1896.		1897.	
	No.	Tons.	No.	Tons.	No.	Tons.
Entrances:						
Foreign	118	26,907	107	20,153	104	24,761
Domestic	32	3,500	7	947	10	14,400
Clearances:						
Foreign	104	8,233	101	17,120	102	25,400
Domestic	48	7,650	24	12,621	45	19,200

Articles.	1895.	1896.	1897.
Imported.	*Tons.*	*Tons.*	*Tons.*
Coal	.....	49,900	47,000
Salt	27,000	24,000	25,000
Lumber	a 397,000	500	2,200
Merchandise	.....	25,000	4,000
Miscellaneous	3,000	500	2,000
Exported.			
Coal	.....	.....	200
Salt	250	1,000	1,200
Merchandise	.....	.....	1,000

a Feet.

All classes of vessels frequent the harbor. Greatest draft, 23 feet. Number of vessels boarded by United States boarding officer, 5,240.

B 7.

IMPROVEMENT OF HARBOR AT MANCHESTER, MASSACHUSETTS.

Manchester Harbor is situated about 5½ miles northeast from the entrance of Salem Harbor, Massachusetts.

The channel was 100 feet wide and 6½ feet deep at mean low water up to Proctors Point; it then shoaled rapidly to a depth of 1½ feet at "The

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Narrows," 1,400 feet from Proctors Point, and for a farther distance of 2,500 feet to the town wharves no low-water channel existed.

The project for its improvement, submitted November 28, 1887, proposed to dredge a channel from Proctors Point to the town wharves 60 feet wide and 4 feet deep at mean low water, at an estimated cost of $14,300.

A chart of the harbor was published in the Annual Report of the Chief of Engineers for 1888, part 1, page 466.

The total appropriations to date have been $14,300.

The expenditures to June 30, 1896, were $13,653.04, and at that date the improvement was essentially completed. The channel was 60 feet wide, 4 feet deep, and 4,000 feet long; opposite the town wharf it was 80 feet wide.

During the fiscal year no operations in improvement of the harbor were in progress.

The river and harbor act of June 3, 1896, provides that—

> The Secretary of War is directed, out of the appropriation on hand, to cause a survey and estimate of cost of improvement to be made with a view of straightening the channel between the mouth of Manchester Harbor and Proctors Point, removing obstructions at the mouth of the channel and at the point of rocks, dredging the channel for its entire length between its mouth and the town wharf to a width of from two hundred feet, narrowing to one hundred and fifty feet, and a depth of eight feet, and providing turning basins and anchorage for boats by the dredging of the flats for that purpose.

The survey ordered by this act was made in August, 1896, and a project and an estimate of cost thereof in accordance with the act were submitted April 7, 1897.

This project was published as House Doc. No. 29, Fifty-fifth Congress, first session.

The estimated cost of the project was $139,966.09.

The commerce involved in this improvement consists of supplies of coal, lumber, etc., for local consumption. The improvement in its present condition has greatly facilitated the approach of vessels to the town wharves.

The value of the commerce involved is approximately $30,000 annually.

Commercial statistics are included in the statement for Gloucester Harbor, Massachusetts.

Manchester Harbor is in the collection district of Gloucester, Mass., of which Gloucester is the port of entry. The nearest light-house is on Bakers Island, 2¼ miles from Proctors Point.

Money statement.

July 1, 1896, balance unexpended	$646.96
June 30, 1897, amount expended during fiscal year	593.92
July 1, 1897, balance unexpended	53.04

The total appropriations for this improvement to date have been:

By the act of—	
August 11, 1888	$2,500
September 19, 1890	5,000
July 13, 1892	6,800
Total	14,300

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B 8.

IMPROVEMENT OF HARBOR AT LYNN, MASSACHUSETTS.

Lynn Harbor is 9 miles northeast from Boston.

The orignal channels were narrow and crooked, and had but 6 feet depth at mean low water.

The project for improvement was adopted in 1884. It proposed a channel 200 feet wide, 10 feet deep at mean low water, through the outer and inner bars. It is supposed that the inner channel will require occasional dredging, and a training wall was proposed, if required, to aid in keeping the outer channel open.

On September 24, 1884, it was proposed to extend the inner channel 400 feet within the harbor line and to excavate at its inner end an anchorage basin 500 by 300 feet in area, 10 feet deep at mean low water, at a cost of $25,000.

The estimated cost of the original project was $157,000; adding the cost of the extension of September 24, 1884, the estimated cost is $182,000.

The total appropriations to date have been $128,500.

The total expenditures to June 30, 1896, were $103,500 on the project, and $5,000 on the western or Saugus River channel under act of June 13, 1892. At that date the outer channel and basin were completed; the inner channel was completed for 4,100 feet at its southerly end, and the remainder was 150 feet wide; the western or Saugus River channel was 4,000 feet long, 150 feet wide, 8 feet deep at mean low water.

The approach of vessels to the city wharves was greatly facilitated by the improvement.

The river and harbor act of June 3, 1896, ordered a survey of this harbor "with a view to securing a channel three hundred feet wide and fifteen feet deep at mean low water."

On March 27, 1897, a project was submitted in accordance with this act, the estimated cost of which was $441,813.17.

The river and harbor act of June 3, 1896, appropriated $20,000 for continuing the improvement of this harbor.

On March 10, 1897, a project for the expenditure of the available funds was submitted, recommending that they be expended in widening the inner improved channel to its full projected dimensions.

This project was approved March 13, 1897.

On May 8, 1897, a contract was entered into with Mr. Augustus B. Martin to dredge 40,000 cubic yards, more or less, from the inner channel, at 21⅞ cents per cubic yard, scow measurement.

No operations have been in progress under this contract during the fiscal year, and the condition of the improvement at the date of this report is the same as on June 30, 1896.

To complete this improvement will require an appropriation of $53,500 for the construction of the training wall, but the necessity for this work is not yet apparent.

Lynn is a port of entry in the collection district of Marblehead, Mass. The nearest light-house is Egg Rock (Nahant) Light, 3 miles distant.

Money statement.

July 1, 1896, balance unexpended		$20,000.00
June 30, 1897, amount expended during fiscal year		150.05
July 1, 1897, balance unexpended		19,849.95
July 1, 1897, outstanding liabilities	$25.20	
July 1, 1897, amount covered by uncompleted contracts	8,750.00	
		8,775.20
July 1, 1897, balance available		11,074.75

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The dates and amounts of appropriations for this work are as follows:

Act of—		Act of—	
August 2, 1882	$60,000	August 17, 1894	$7,500
August 5, 1886	6,000	June 3, 1896	20,000
August 11, 1888	10,000		
September 19, 1890	15,000	Total	128,500
July 13, 1892	10,000		

Abstract of proposals for dredging in Lynn Harbor, Massachusetts, opened April 19, 1897, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid per cubic yard.		Total for dredging 40,000 cubic yards.
		For dredging.	Bowlders over 3 tons each.	
		Cents.		
1	Charles H. Souther, Boston, Mass	23	$8	$9,200
2	Eastern Dredging Co., Boston, Mass	24½	10	9,600
3	Augustus B. Martin, Boston, Mass. *a*	21½	8	8,750

a Lowest bid.

The contract was awarded to Augustus B. Martin, with the approval of the Chief of Engineers.

LIST OF CONTRACTS IN FORCE JUNE 30, 1897.

Contract of May 8, 1897; Augustus B. Martin, contractor; date of approval, May 14, 1897; to be commenced June 15, 1897, and to be completed September 30, 1897.

The accompanying commercial statistics were furnished by the collector of customs at Marblehead, Mass.

COMMERCIAL STATISTICS.

Amount of revenue collected, 1895, $832.69; 1896, $298.15; 1897, $77.83.

Shipping.	1895.		1896.		1897.	
	No.	Tons.	No.	Tons.	No.	Tons.
Entrances:						
Foreign	43	4,127	64	6,029	54	5,193
Domestic	2,300	369,714	329	121,000	561	177,265
Clearances:						
Foreign	33	3,229	67	6,238	52	5,044
Domestic	2,306	370,255	329	121,000	561	177,265

Imported.	1895.	1896.	1897.
	Tons.	*Tons.*	*Tons.*
Coal	133,719	158,480	140,900
Iron	256	974	2,089
Lumber	*a* 4,762,680	*a* 7,995,525	*a* 6,820,781
Merchandise	*b* 33,700	*b* 500,000	*b* 85,000
Miscellaneous	*b* 12,000	*b* 475,000	*b* 50,000

a Feet. *b* Lime, hay, bricks, sand, cement, stone, etc.

Lumber imported includes both foreign and domestic.
All classes of vessels frequent the harbor, drawing from 8 to 18 feet of water.

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B 9.

IMPROVEMENT OF MYSTIC AND MALDEN RIVERS, MASSACHUSETTS.

Mystic River empties into the inner harbor of Boston, Mass.

Malden River is tributary to the Mystic River, their junction being 3 miles above the mouth of the latter.

Originally no low-water channel existed in either river.

A project for the improvement of Mystic River was submitted May 9, 1891. It proposed to widen and deepen the natural channel to the head of navigation in Medford, a distance of about 4½ miles, so that it should be 100 feet wide, 6 feet deep at mean low water to the first turn above Denning's wharf, thence 4 feet deep at mean low water, the width gradually contracting to 50 feet at the upper end; estimated to cost $25,000.

The original project for the improvement of Malden River was submitted December 1, 1880. It contemplated the excavation of a channel 100 feet wide and 12 feet deep at mean high water up to the second drawbridge, with two cut-offs, one east of the island, near the junction of the Malden and Mystic rivers, and the other through the marsh land about half a mile above, at a cost of $35,000.

This project was modified in 1882. It was then proposed to make the natural channel 100 feet wide and 12 feet deep at mean high water to the first bridge, and thence 75 feet wide to the second bridge, at an estimated cost of $40,000. The mean rise or fall of tide is 9.8 feet.

This estimate was increased to $47,000 in 1884. (Annual Report, 1884, p. 551.)

Ten thousand dollars was appropriated for this work by the act of 1882, and expended (1883–84) in making the channel from the mouth to the drawbridge in Malden, a distance of 1¼ miles, at least 50 feet wide (70 feet at turns) and 12 feet deep at mean high water.

November 1, 1890, a project was submitted for the improvement of this river in conjunction with Mystic River. This project proposed the completion of the project of 1882 at an estimated cost of $37,000.

The total appropriations to date under present approved projects have been $30,000.

The expenditures to June 30, 1896, under the present projects were $20,000.

At that date the channel in Mystic River was 6 feet deep at mean low water and 100 feet wide to the first turn above Denning's wharf, and for 1,500 feet above this turn it was 4 feet deep and at least 50 feet wide. The channel in Malden River was at least 75 feet wide and 12 feet deep at mean high water to the first bridge, above which nothing had been done.

The river and harbor act of June 3, 1896, appropriated $10,000 for the improvement of these rivers, and on June 20, 1896, a project for expenditure was submitted. It proposed to expend the available funds ($5,000 on each river) in completing the improvement of Mystic River so far as the money would admit in the completion of the project for Malden River below the first bridge, and in making a cut of full depth and 25 feet wide above the bridge.

On October 19, 1896, a contract was entered into with Mr. Augustus B. Martin to dredge 26,000 cubic yards, more or less, at 34½ cents per cubic yard, from these rivers.

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Operations under this contract were commenced June 17, 1897, and during the fiscal year 1,864 cubic yards were dredged from Malden River.

These operations have resulted as yet in no material change, and the condition of the improvement is practically the same as on June 30, 1896.

To complete the improvement of Mystic River would require an appropriation of $10,000, and of Malden River $22,000, a total of $32,000, all of which could be expended to advantage during the fiscal year ending June 30, 1899.

Mystic and Malden rivers are in the collection district of Boston, Mass., of which Boston is the port of entry. The nearest light-house is on Long Island, Boston Harbor, Massachusetts.

Money statement.

July 1, 1896, balance unexpended		$10,000.00
June 30, 1897, amount expended during fiscal year		117.08
July 1, 1897, balance unexpended		9,882.92
July 1, 1897, outstanding liabilities	$643.08	
July 1, 1897, amount covered by uncompleted contracts	8,326.92	
		8,970.00
July 1, 1897, balance available		912.92
Amount (estimated) required for completion of existing project		32,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		32,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

The dates and amounts of appropriations for this work are as follows:

For Malden River, by act of August 2, 1882	$10,000
For Mystic and Malden rivers, by act of July 13, 1892	10,000
For Mystic and Malden rivers, by act of August 17, 1894	10,000
For Mystic and Malden rivers, by act of June 3, 1896	10,000
Total	40,000

Abstract of proposals for dredging in Mystic and Malden rivers, Massachusetts, opened September 29, 1896, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price per cubic yard.		Total yards that can be dredged.
		For dredging.	Bowlders over 3 tons each.	
		Cents.		
1	Charles H. Souther, Boston, Mass.	41	$10.00	24,390
2	Augustus B. Martin, Boston, Mass. *a*	34½	5.00	28,985
3	Eastern Dredging Co., Boston, Mass.	36	5.00	26,315

a Lowest bid.

The contract was awarded to Augustus B. Martin, with the approval of the Chief of Engineers.

CONTRACTS IN FORCE JUNE 30, 1897.

Contract dated October 19, 1896: Augustus B. Martin, contractor; date of approval, October 27, 1896; to be commenced April 1, 1897; to be completed December 31, 1897.

Commercial statistics are included in statement for Boston Harbor.

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B 10.

IMPROVEMENT OF HARBOR AT BOSTON, MASSACHUSETTS.

Boston Harbor consists essentially of an inner and an outer harbor united by a deep waterway, and each accessible from the sea by a distinct channel, widening into a deep and spacious roadstead.

1. Inner harbor.—This harbor lies to the north and westward of Long Island and has deep water and good anchorage in the President Roads, seaward of Lower Middle Bar, and also near the city westward of Upper Middle Bar.

Four rivers discharge their waters into the basin, the Charles, Mystic, and Chelsea rivers from the north and the Neponset from the south. The direct entrance from the sea is by Broad Sound.

2. Outer harbor.—This harbor lies to the southward of Long Island and has a fine anchorage in Nantasket Roads, as well as in Hingham Bay, a well-sheltered harbor southeast of Peddocks Island. It connects with the inner harbor by the main ship channel through the Narrows, and by secondary channels east and west of Long Island. It is reached from the sea by Nantasket Roads, which lie south of Georges and Great Brewster islands, and is marked at the sea entrance by Boston Light.

Weymouth and Weir rivers empty into the outer harbor.

Both the inner and outer harbors are subdivided into several minor harbors, and contain many islands which shelter the anchorage from winds and storm waves.

The range of the tide at the navy-yard is 9.8 feet, and at the entrance to the outer harbor 9.4 feet. A sketch of the harbor was printed in the Annual Report of the Chief of Engineers for the year 1888, page 454.

The object of the improvement is, first, to preserve the harbor by protecting the islands and headlands; and second, to improve it by widening, deepening, and straightening the channels.

The works of preservation consist of sea walls, aprons, jetties, etc., which protect the shores of the islands and headlands, prevent additional wash into the channels, control the tidal scour, and preserve the full height of anchorage shelter from vessels in the roadsteads.

The works of improvement have been by dredging and blasting.

The total appropriations from 1825 to date have been $3,274,276.10.

The total expenditures to June 30, 1896 (not including outstanding liabilities), were $2,629,821.85.

WORKS OF PRESERVATION.

The location and details of these works are given in the Annual Report of the Chief of Engineers for 1895, pages 621 and 622.

With the exception of the sea walls at Deer Island, they were all in fair order on June 30, 1896, and no work has been done on them during the year. They are generally strongly built, massive structures, but in very exposed positions, and liable to damage from storms. These damages are most economically repaired when they first occur, and funds for this purpose should always be on hand.

On June 30, 1896, repairs were being made to the north and middle head sea walls at Deer Island; 150 running feet of wall, 300 running feet of concrete and earth backing, and 400 running feet of the paving needed resetting, at an estimated cost of $8,000.

These repairs were continued during the fiscal year and at the date of this report are nearly completed, but other weak points in the walls were developed by last winter's storms which will necessitate additional repairs, at an estimated cost of $2,500.

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WORKS OF IMPROVEMENT.

The main ship channel.—Before improvement it had a least width of 100 feet and a least depth of 18 feet at mean low water. The original project for its improvement was submitted in 1867. It proposed to dredge the channel 23 feet deep at mean low water, 1,000 feet wide at the Upper and Lower Middles, and 685 feet at the Narrows.

In 1870 the proposed width at the Narrows was reduced to 625 feet and increased to 1,100 feet at the anchorage shoal in the inner harbor.

Under this project, to June 30, 1895, the main ship channel was made 23 feet deep at mean low water, 1,100 feet wide west of the Upper Middle, 850 feet wide at the Upper Middle, 1,000 feet wide at the Lower Middle, and at least 625 feet wide elsewhere.

A list of the positions where dredging and blasting were done in effecting this improvement will be found in the Annual Report of the Chief of Engineers for 1895, page 623.

To complete this project of 1867 the Upper Middle must be widened to 1,000 feet and the Point Allerton sea wall must be extended, sea walls built at Georges and Governors islands, and the Fort Point Channel completed, which works are estimated to cost $350,000.

A revised project for the improvement of the main channel was submitted August 11, 1892. It proposed, in accordance with the act of July 13, 1892, to widen and deepen the channel so that it should be 1,000 feet wide and 27 feet deep at mean low water. This revised project was estimated to cost $1,250,000.

On June 30, 1896, under this project the main channel had been dredged to make it 27 feet deep at mean low water, 1,000 feet wide from the entrance (near the outer light) to Bug Light, and in the Narrows 800 feet wide to the passage between Georges and Gallops islands, where it is at least 550 feet wide; but the free use of this 27-foot channel was restricted by reason of ledges uncovered by the dredging.

Operations were in progress under a contract with Messrs. Townsend & Johnston, of Somers Point, N. J., to remove 8,772 cubic yards of ledge, at $16.48 per cubic yard, from the main channel, and were continued during the fiscal year. At the date of this report 6,421 cubic yards of ledge has been removed under the contract, and a width of at least 350 feet of the 27-foot channel has been cleared of ledges.

No other operations were in progress on the main ship channel during the fiscal year, and at the date of this report the main ship channel is 27 feet deep at mean low water, 1,000 feet wide from the entrance to Bug Light, 800 feet wide thence to the passage between Georges and Gallops islands, and thence 550 feet wide through the remainder of the Narrows; elsewhere it is in the same condition as on June 30, 1895.

The total appropriations for this revised project of 1892 are:

By the act of—	
July 13, 1892	$265,000
August 17, 1894	190,000
Sundry civil act June 4, 1897	400,000
Total	855,000

The act of June 3, 1896, provides as follows:

Improving harbor at Boston, Massachusetts: Continuing improvement, seventy thousand dollars: *Provided*, That this sum may, in the discretion of the Secretary of War, be used in the preservation and improvement of said harbor, including the project for improving the main ship channel, and that seven thousand dollars of this sum may, in the discretion of the Secretary of War, be used in improving Chelsea Creek, and so much thereof as the Secretary of War in his discretion shall direct to be expended for the protection of Great Head, Winthrop, to prevent the further washing away by the action of the sea: *Provided*, That contracts may be entered into

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by the Secretary of War for such materials and work as may be necessary to carry out the revised project of August eleventh, eighteen hundred and ninety-two, such contracts to provide that said ship channel shall be widened to a minimum width of one thousand feet and a minimum depth of twenty-seven feet, to be paid for as appropriations may from time to time be made by law, in the aggregate not to exceed one million one hundred and forty-five thousand dollars, exclusive of amount herein and heretofore appropriated.

On February 11, 1897, a contract was entered into with Messrs. Breymann Bros., of Toledo, Ohio, to dredge 2,910,718 cubic yards, more or less, from the main ship channel, in completion of the project of August 11, 1892.

No work has yet been done under this contract.

On October 19, 1896, a contract was entered into with Augustus B. Martin to dredge 21,000 cubic yards, more or less, of material from Chelsea Creek.

The project for the improvement of this tributary channel was submitted December 21, 1894. It proposed to dredge a channel 150 feet wide and 18 feet deep at mean high water to the head of navigation, at an estimated cost of $65,000.

In its original condition about 14 feet at mean high water could be carried in a narrow and tortuous channel, difficult of navigation. No work had been done under this project up to the beginning of the year.

Operations under the contract were commenced in November, 1896, and completed in March, 1897, resulting in a channel 14 feet deep at mean high water, at least 35 feet wide, and of greatly increased width at turns.

By the act of September 19, 1890, $20,000 was appropriated for the improvement of Charles River, provided "that the draws in the Arsenal Street and Market Street bridges shall be made to conform to the projected channel without cost to the United States." This sum still remains unexpended because the Market Street Bridge has not been remodeled.

For a list of the other tributary channels of the harbor which from time to time have been improved, and their condition June 30, 1895, see Annual Report of the Chief of Engineers for 1895, pages 625–627. No operations were in progress on these minor works during the year, and they remain in the same condition as on June 30, 1895.

To complete the project of 1867 will require an appropriation of $350,000; to complete the project of 1892, $395,000; total, $745,000. All of this amount could be expended to advantage during the fiscal year ending June 30, 1899.

The several works completed and projected for the improvement of this harbor are located in the collection district of Boston and Charlestown, Mass. Boston is the port of entry.

Money statement.

July 1, 1896, balance unexpended		$244,454.25
Amount appropriated by sundry civil act approved June 4, 1897		400,000.00
		644,454.25
June 30, 1897, amount expended during fiscal year		100,243.89
July 1, 1897, balance unexpended		544,210.36
July 1, 1897, outstanding liabilities	$11,424.07	
July 1, 1897, amount covered by uncompleted contracts	438,744.48	
		450,168.55
July 1, 1897, balance available		94,041.81
Amount (estimated) required for completion of existing project		745,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		745,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

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The dates and amounts of the appropriations for this work are as follows:

Act of—		Act of—	
March 2, 1825	$52,972.56	July 11, 1870	$100,000.00
March 19, 1828	2,000.00	March 3, 1871	100,000.00
May 23, 1828	87,000.00	June 10, 1872	75,000.00
March 2, 1829	7,310.54	March 3, 1873	150,000.00
March 2, 1831	5,000.00	June 23, 1874	100,000.00
March 2, 1831	12,390.00	March 3, 1875	100,000.00
February 24, 1832	9,000.00	August 14, 1876	50,000.00
July 3, 1832	60,000.00	June 18, 1878	55,000.00
July 4, 1836	15,000.00	March 3, 1879	50,000.00
July 7, 1838	7,353.00	June 14, 1880	75,000.00
March 3, 1841	1,000.00	March 3, 1881	100,000.00
March 3, 1841	1,500.00	August 2, 1882	96,500.00
August 31, 1842	2,000.00	July 5, 1884	5,000.00
March 3, 1843	16,000.00	August 5, 1886	56,250.00
July 20, 1848	40,000.00	August 11, 1888	125,000.00
August 30, 1852	30,000.00	September 19, 1890	145,000.00
July 2, 1864	40,000.00	July 13, 1892	300,000.00
July 2, 1864	10,000.00	August 17, 1894	200,000.00
February 28, 1865	3,000.00	June 3, 1896	70,000.00
February 28, 1865	20,000.00	June 4, 1897	400,000.00
June 12, 1866	50,000.00		
July 12, 1866	75,000.00	Total	3,274,276.10
March 2, 1867	375,000.00		

The accompanying commercial statistics for the fiscal year ending June 30, 1897, have been furnished by the collector of customs at Boston, Mass.

Abstract of proposals for removal of ledges from Boston Harbor, Massachusetts, opened October 22, 1894, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid per cubic yard.	Total.
1	Townsend & Johnston, Somers Point, N. J. *a*	$16.48	$144,562.56
2	P. Sandford Ross, Jersey City, N. J.	18.00	157,896.00
3	Geo. Willett Andrews, Biddeford, Me	16.62	145,790.64

a Lowest bid.

The contract was awarded to Townsend & Johnston, with the approval of the Chief of Engineers.

Abstract of proposals for dredging in Chelsea Creek, Boston Harbor, Massachusetts, opened September 28, 1896, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid per cubic yard.		Total yards that can be dredged.
		For dredging.	Bowlders over 6 tons each.	
1	Lyman Boynton, Boston, Mass	$0.29½	$10.00	23,529
2	Charles H. Souther, Boston, Mass	.37	10.00	18,918
3	Augustus B. Martin, Boston, Mass. *a*	.29	5.00	24,137
4	Eastern Dredging Co., Boston, Mass	.31½	5.00	22,222

a Lowest bid.

The contract was awarded to Augustus B. Martin, with the approval of the Chief of Engineers.

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Abstract of proposals for dredging in Boston Harbor, Massachusetts, opened January 28, 1897, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and residence of bidder.	Price bid per cubic yard measured in scows.	Price bid for removing bowlders weighing over 6 tons each per cubic yard.	Total.
1	Charles H. Souther, and Augustus R. Wright, Boston, Mass.	$0.21⅞	$5.00	$636,719.56
2	American Dredging Co., by L. Y. Schermerhorn, president, Philadelphia, Pa.	.29	15.00	844,108.22
3	Alabama Dredging and Jetty Co., by E. L. Merkel, president, Mobile, Ala.	.40	8.00	1,164,287.20
4	Perkins, White & Co., and John J. O'Brien & Co., Boston, Mass.	.28⅛	10.00	829,554.63
5	Baltimore Dredging Co., by F. A. Furst, president, Baltimore, Md.	.27½	(a)	800,447.45
6	John B. & Eugene Breymann, Toledo, Ohio b	.17½	12.00	509,375.65
7	Morris & Cumings Dredge Co., by George Leary, president, New York, N. Y.	.26½		771,340.27

a Informal. b Lowest bid.

The contract was awarded to Breymann Bros., with the approval of the Chief of Engineers.

LIST OF CONTRACTS IN FORCE JUNE 30, 1897.

Contract dated November 27, 1894; Townsend & Johnston, contractors; to remove 8,772 cubic yards of ledge from Boston Harbor, Massachusetts, at $16.48 per cubic yard; approved December 4, 1894; to be commenced November 27, 1894; to be completed November 27, 1896; time of completion extended on November 23, 1896, to June 30, 1897, and further extended June 23, 1897, to October 30, 1897.

Contract dated February 11, 1897; Breymann Bros., of Toledo, Ohio, contractors; to dredge 2,910,718 cubic yards, more or less, of material from the main ship channel, Boston Harbor, Massachusetts, at 17½ cents per cubic yard; approved March 9, 1897; to be commenced April 1, 1897; to be completed June 30, 1900.

COMMERCIAL STATISTICS.

Amount of revenue collected, 1895, $9,486,115.75; 1896, $11,219,468.31; 1897, $12,425,973.65.

Shipping.	1895.		1896.		1897.	
	No.	Tons.	No.	Tons.	No.	Tons.
Entrances:						
Foreign	2,106	1,764,494	1,980	1,650,270	1,805	1,780,726
Domestic	.....	.....	214	107,021	260	163,153
Clearances:						
Foreign	1,942	1,423,257	1,874	1,398,580	1,623	1,475,017
Domestic	.....	.....	308	124,516	324	150,294

	1895.	1896.	1897.
Importations:			
Merchandise	$66,822,576	$79,179,864	$90,178,419
Coin and bullion	6,469	.....	3,724,582
Exportations:			
Foreign merchandise	469,978	1,212,826	1,405,676
Coin and bullion	9,200	1,200	4,000
Domestic merchandise	85,049,161	94,638,178	99,451,605
Coin and bullion	4,000	.....	1,000

Number of coastwise arrivals as published by the chamber of commerce: 1894, 8,419; 1895, 9,166; 1896, 9,684.

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B 11.

IMPROVEMENT OF TOWN RIVER, MASSACHUSETTS.

Town River is a small tidal river, tributary to Weymouth River, which empties into Boston Harbor on the south.

The wharves of the city of Quincy are about 1½ miles above its mouth.

The upper half of the river has a narrow, crooked channel, in which but 1½ feet of water can be carried at mean low water.

The project for its improvement, submitted December 31, 1890, proposed to dredge a channel 4,500 feet long, 100 feet wide, 4 feet deep at mean low water to the head of navigation, at an estimated cost of $20,000.

The only appropriation to date was by act of June 3, 1896, $10,000.

On June 30, 1896, no work had been done under the project, and the original condition of the river was unaltered.

On June 20, 1896, a project was submitted for the expenditure of the appropriation made by the river and harbor act of June 3, 1896.

This project proposed to dredge the southern half of the proposed channel. This project was approved by the Secretary of War, July 24, 1896.

On October 15, 1896, a contract was entered into with Perkins & White to dredge 33,000 cubic yards from the river, at 27 cents per cubic yard, scow measurement.

On March 24, 1897, the estimate of cost of the project of improvement was revised in accordance with Department letter 16,423, dated August 7, 1896.

The estimate was increased $5,000, making the estimated cost $25,000. This increase was necessary because of the increased price per cubic yard for dredging obtained in October, 1896, over the estimated cost of 23 cents per cubic yard in the estimate of 1890.

Operations were commenced under the contract of October 15, 1896, late in the fiscal year, but at the date of this report the original condition of the river remains practically unchanged.

To complete the improvement would require an appropriation of $15,000, all of which could be expended during the fiscal year ending June 30, 1898.

Town River, Massachusetts, is in the collection district of Boston, Mass., of which Boston is the port of entry; the nearest light-house is on Long Island, Boston Harbor, Massachusetts.

The local commerce consists of coal, lumber, etc., and the output of the Quincy granite quarries.

The value of this commerce annually will approximate $200,000.

Money statement.

July 1, 1896, balance unexpended		$10,000.00
June 30, 1897, amount expended during fiscal year		105.72
July 1, 1897, balance unexpended		9,894.28
July 1, 1897, outstanding liabilities	$1,345.68	
July 1, 1897, amount covered by uncompleted contracts	7,564.32	
		8,910.00
July 1, 1897, balance available		984.28
Amount (estimated) required for completion of existing project		15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

The date and amount of appropriation for this work is as follows:

Act of June 3, 1896	$10,000

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Abstract of proposals for dredging in Town River, Massachusetts, opened September 28, 1896, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid per cubic yard.		Total yards that can be dredged.
		For dredging.	Bowlders over 3 tons each.	
1	Perkins & White, Boston, Mass. *a*	$0.27	$8.00	37,037
2	Charles H. Souther, Boston, Mass	.45	10.00	22,222
3	Augustus B. Martin, Boston, Mass	.35	5.00	28,571
4	Eastern Dredging Co., Boston, Mass	.32	3.00	31,250

a Lowest bid.

The contract was awarded to Messrs. Perkins & White with the approval of the Chief of Engineers.

LIST OF CONTRACTS IN FORCE JUNE 30, 1897.

Contract dated October 15, 1896; contractors, Messrs. Perkins & White; contract approved October 27, 1896; to be commenced April 1, 1897; to be completed December 31, 1897.

B 12.

IMPROVEMENT OF WEYMOUTH RIVER, MASSACHUSETTS.

Weymouth (Fore) River empties into the southwestern part of Boston Harbor, Massachusetts. For 4 miles it was navigable at low water for vessels drawing 18 feet, and to the head of navigation, an additional 3 miles, at least 3 feet depth was to be found.

The original project for its improvement was submitted December 2, 1889. It proposed to improve the natural channel so that 6 feet at mean low water could be carried to the head of navigation in a channel 100 feet wide to near Weymouth Landing; thence to Braintree Bridge 80 feet wide, and above the bridge 50 feet wide; the total length of improved channel to be 7,000 feet, and to cost $40,000.

The total appropriations to date have been $40,000, of which $12,500 must be expended on the "Back" River.

The expenditures to June 30, 1896, were $22,309.58, and at that date the improved channel was 6 feet deep and 60 feet wide to within 700 feet of Braintree Bridge, 40 feet wide thence to Braintree Bridge, and 25 feet wide above the bridge.

On June 20, 1896, a project was submitted for the expenditure of the appropriation made available for this river by the river and harbor act of June 3, 1896. This recommendation would complete the project above Braintree Bridge, and make the channel below that bridge not less than 60 feet wide; it was approved by the Secretary of War July 24, 1896.

On October 19, 1896, a contract was entered into with Mr. Augustus B. Martin to dredge 9,000 cubic yards, more or less, from the river at 47 cents per cubic yard.

Operations under the contract were commenced April 22, 1897, and finished May 27, 1897.

Nine thousand cubic yards were removed, and at the date of this report the project is completed above Braintree Bridge, and the channel is of full depth and at least 60 feet wide below the bridge, except over four ledges uncovered by the dredging.

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Weymouth (Back) River lies east of the Fore River and forms the boundary between the towns of Weymouth and Hingham. It empties into Boston Harbor at the mouth of Fore River.

Originally 6 feet at mean low water could be carried to the wharf of the Bradley Fertilizer Company, a distance of about 7,000 feet. For a further distance of about 8,800 feet a channel exists navigable only at high water.

The project for the improvement of Weymouth (Back) River was submitted February 7, 1891. It proposed to dredge a channel through the outer bar 200 feet wide and 12 feet deep at mean low water, and to widen and deepen the natural channel of the river to the same dimensions, to the wharf of the Fertilizer Company, at an estimated cost of $22,000.

No expenditures had been made on Weymouth (Back) River up to June 30, 1896, and the original condition of the channel was unaltered at that date.

On June 20, 1896, a project was submitted for the expenditure of the available funds. It proposed to complete the channel through the outer bar, and make the channel thence to the Fertilizer Company's wharf at least 100 feet wide, and of full projected depth.

This project was approved by the Secretary of War July 24, 1896.

On October 16, 1896, a contract was entered into with Mr. Charles H. Souther to dredge 48,000 cubic yards of material from the river at 23 cents per cubic yard.

Operations under this contract were commenced April 12, 1897, and completed in June, 1897. Forty-eight thousand and eighty-six cubic yards were dredged, and at the date of this report the channel is at least 12 feet deep at mean low water, 200 feet wide through the bar, and 125 feet wide thence to the Fertilizer Company's wharf.

The amount required to complete the improvement of Weymouth (Fore) River is $12,500; to complete Weymouth (Back) River, $9,500; total, $22,000.

Weymouth River is in the collection district of Boston, Mass., of which Boston is the port of entry. The nearest light-house is on Long Island, Boston Harbor, Massachusetts.

Money statement.

July 1, 1896, balance unexpended	$17,690.42
June 30, 1897, amount expended during fiscal year	16,144.03
July 1, 1897, balance unexpended	1,546.39
Amount (estimated) required for completion of existing project	22,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	22,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

The dates and amounts of the appropriations for this work are as follows:

By act of—	
September 19, 1890	$10,000
July 13, 1892	10,000
August 17, 1894	5,000
June 3, 1896	15,000
Total	40,000

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Abstract of proposals for dredging in Weymouth (Fore) River, Massachusetts, opened September 28, 1896, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid per cubic yard.		Total yards that can be dredged.
		For dredging.	Bowlders over 6 tons each.	
1	Augustus B. Martin, Boston, Mass. *a*	$0.47	$10	10,638
2	Eastern Dredging Company, Boston, Mass	.49	5	10,204

a Lowest bid.

The contract was awarded to Augustus B. Martin, with the approval of the Chief of Engineers.

Abstract of proposals for dredging in Weymouth (Back) River, Massachusetts, opened September 28, 1896, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid per cubic yard.		Total yards that can be dredged.
		For dredging.	Bowlders over 6 tons each.	
1	Perkins & White, Boston, Mass	$0.33	$8	37,878
2	Charles H. Souther, Boston, Mass. *a*	.23	10	54,347
3	Augustus B. Martin, Boston, Mass	.26	5	48,076
4	Eastern Dredging Company, Boston, Mass	.25½	5	49,019

a Lowest bid.

The contract was awarded to Charles H. Souther, with the approval of the Chief of Engineers.

No contracts were in force on June 30, 1896.

Commercial statistics are included in the statement for Boston Harbor, Massachusetts.

The character of commerce benefited by the improvement of this river is the supply of coal, lumber, and general merchandise to the populous district surrounding it. The annual value of this commerce approximates $750,000.

B 13.

IMPROVEMENT OF HARBOR AT SCITUATE, MASSACHUSETTS.

Scituate Harbor is on the west shore of Massachusetts Bay, 14 miles from either Boston or Plymouth light-houses, and just southwest of the direct sailing course of all ocean-going vessels entering Boston Harbor.

Before improvement the harbor had a low-water area of 57 acres, approximately, more than 6 acres of which had a depth of at least 3 feet at mean low water. It was entirely open to the action of east winds, and the entrance was obstructed by many sunken bowlders. The depth on the bar was about 2½ feet at mean low water. The mean rise or fall of the tide is 9.8 feet.

The object of the improvement is to create a harbor of refuge for vessels bound to Boston which are too far south of their course to clear the dangerous ledges near Minots light-house.

The project of improvement, adopted in 1881, is to build two rubble-stone breakwaters converging from opposite shores, and to dredge an

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anchorage basin with channels connecting with the sea and the town wharves. The anchorage basin is to be 30 acres in area, approximately. The entrance channel is to be 2,700 feet long and 300 feet average width. The depths proposed were 15 feet in the entrance channel, 12 to 15 feet between the breakwaters, 12 feet immediately in the rear of the south breakwater, and 10 feet for the anchorage basin; the channel leading to the town wharves is to be 3 feet deep, all at mean low water.

The estimated cost of the breakwater was $100,000, and of dredging $190,000; a total of $290,000.

The plan of the harbor, showing the proposed improvement, was published in the Annual Report of the Chief of Engineers for 1881, part 1, page 522.

The total amount appropriated for this work to date is $89,680, of which $1,180 was expended before the present project was adopted.

The amount expended to June 30, 1896, was $82,500.

At that date the condition of the improvement was as follows:

A portion of the beach between Cedar Point and the mainland was protected by a brush-and-stone bulkhead 450 feet long, in front of which was a stone apron 10 feet wide, 385 feet long.

All known bowlders obstructing the entrance of the harbor were removed.

The anchorage basin was 400 by 350 feet in area, 7 feet deep at mean low water.

The entrance channel was 1,600 feet long, 100 feet wide, and 5 feet deep at mean low water. The channel connecting the basin with the town wharves was 3 feet deep at mean low water, and 100 feet wide, except at the upper end, where, for a distance of 75 feet, it averaged only 50 feet wide.

The north breakwater was 720 feet long, the south breakwater 450 feet long.

On June 20, 1896, a project was submitted for the expenditure of $6,000, appropriated by the river and harbor act of June 3, 1896.

This project proposed to dredge the entrance channel to 7 feet depth at mean low water, 75 feet wide, and was approved July 11, 1896.

On October 15, 1896, a contract was entered into with the Eastern Dredging Company to dredge 14,000 cubic yards, more or less, from the channel.

Operations were commenced under this contract in June, 1897, and during the fiscal year the contractor dredged 6,114 cubic yards. This small part of the work to be done under the contract has produced no increased available depth in the entrance channel, and at the date of this report the condition of the improvement is practically the same as on June 30,1896.

Money statement.

July 1, 1896, balance unexpended		$6,000.00
June 30, 1897, amount expended during fiscal year		116.53
July 1, 1897, balance unexpended		5,883.47
July 1, 1897, outstanding liabilities	$2,353.89	
July 1, 1897, amount covered by uncompleted contracts	3,036.11	
		5,390.00
July 1, 1897, balance available		493.47
Amount (estimated) required for completion of existing project		201,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

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The dates and amounts of the appropriations for this work are as follows:

Act of—		Act of—	
March 2, 1829	$180	August 11, 1888	$5,000
August 30, 1852	1,000	September 19, 1890	10,000
June 14, 1880	7,500	July 13, 1892	10,000
March 3, 1881	10,000	August 17, 1894	10,000
August 2, 1882	10,000	June 3, 1896	6,000
July 5, 1884	10,000		
August 5, 1886	10,000	Total	89,680

Abstract of proposals for dredging in Scituate Harbor, Massachusetts, opened September 28, 1896, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid per cubic yard.		Total yards that can be dredged.
		For dredging.	Bowlders over 3 tons each.	
1	Charles H. Souther, Boston, Mass	$0.45	$8.00	13,333
2	Augustus B. Martin, Boston, Mass	.45	5.00	13,333
3	Eastern Dredging Co., Boston, Mass. *a*	.38½	3.00	15,584

a Lowest bid.

The contract was awarded to the Eastern Dredging Company, with the approval of the Chief of Engineers.

CONTRACTS IN FORCE JUNE 30, 1897.

Contract dated October 15, 1896: Eastern Dredging Company, contractors; contract approved October 31, 1896; date of commencement, June 1, 1897; to be completed December 31, 1897.

The accompanying commercial statistics have been furnished by the collector of customs at Plymouth, Mass.

COMMERCIAL STATISTICS.

Amount of revenue collected, 1895, —; 1896, —; 1897, $76.47.

Shipping.	1895.		1896.		1897.	
	No.	Tons.	No.	Tons.	No.	Tons.
Entrances:						
Foreign	1	125	1	400	3	290
Domestic	39	5,000	39	5,840	42	.....
Clearances:						
Foreign	1	.....	1	400	3	290
Domestic	.....	.....	39	5,840	42	.....

Imports.	1895.	1896.	1897.
Coal, tons	3,500	5,000	5,000
Lumber, feet	1,100,000	3,000,000	3,500,000
Lime and cement, barrels	1,000	.....	1,500
Brick, number	.....	.....	450,000
Shingles, do	2,500,000	.....	.....
Miscellaneous, barrels	*a* 7,500	*a* 10,000	*a* 15,000

a Irish moss exported.

Vessels frequenting the harbor, two and three masted schooners; draft of water, 10½ feet.

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B 14.

IMPROVEMENT OF HARBOR AT PLYMOUTH, MASSACHUSETTS.

Plymouth Harbor is situated 30 miles south of Boston. Its outer anchorage, the "Cow Yard," is common to Plymouth, Kingston, and Duxbury, and is the only refuge for seagoing vessels from northeasterly gales when caught between Boston and Provincetown, a distance of about 75 miles, following the coast line. The entrance to this outer anchorage is direct, unobstructed, of ample width, and sufficiently deep for the wants of commerce. The anchorage is capacious, and has good "holding ground," but the extensive tidal basins inside of it give strong variable currents across it.

The inner or harbor proper is formed by Long Beach, a narrow, low sand spit 3 miles long, which extends generally parallel to the mainland and about 1 mile from it.

The harbor contains about 2,000 acres, almost all of which is dry at low tide. A few narrow, crooked channels traverse these flats. They join about the center of the harbor, opposite the town wharves, and form the main ship channel (150 feet wide, approximately, and 10 feet deep at mean low water), which runs directly behind the northern half of Long Beach to the outer anchorage.

The maintenance of this inner harbor or channel depends on the preservation of Long Beach.

A chart of the harbor was published in the Annual Report of the Chief of Engineers for the year 1888, part 1, page 460.

Before improvement about 6 inches depth of water could be carried to the town wharves at low tide.

Previous to 1875 the project was a general one, and had for its object the preservation of Long Beach. From the nature of the work it can at no time be considered completed, and small annual appropriations are necessary to repair any damages done by storms. The various devices employed for this purpose are described in the Annual Report of the Chief of Engineers for 1877.

The project for the improvement of the harbor was first adopted in 1875. It provided for dredging a channel from the town wharves to the main ship channel 2,286 feet long, 100 feet wide, and 6 feet deep at mean low water. This project was modified in 1877 so as to include the dredging of a basin 866 feet long, 150 feet wide, and 8 feet deep directly in front of the town wharves.

In 1884 and 1885 it was proposed to deepen the channel and basin to 9 feet at mean low water, and to make the channel 150 feet wide.

The modified project of 1884 required the excavation of 81,000 cubic yards (scow measurement), and was originally estimated to cost $27,000. This estimate was revised in 1885 in accordance with the low prices then current for dredging, and the cost was then estimated to be $22,500.

From 1824 to date the amount appropriated for this harbor is $182,766.90, of which there had been expended to June 30, 1896:

For beach protection	$127,263.34
For dredging	50,514.89
Total	177,778.23

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On June 30, 1896, the project for improvement had been completed. Long Beach was in good order.

The river and harbor act of June 3, 1896, ordered a survey to be made and project submitted for further improvement of the harbor, and on April 24, 1897, a plan and project for improvement were submitted, the estimated cost of which was $8,716.95.

This report and project were published as House Doc. No. 39, Fifty-fifth Congress, first session.

The storms of the winter of 1896–97 created breaches in the beach protection of Long Beach at points about midway of its length, which necessitated extensions of the protecting bulkheads.

On March 31, 1897, an agreement was entered into with Messrs. Burgess & Marks, of Plymouth, Mass., for the construction of 600 feet, more or less, of bulkhead, at $1.44½ per running foot.

Operations under this agreement were commenced April 27, 1897, and during the fiscal year 1,216.5 feet of bulkhead was constructed.

At the date of this report the condition of the beach is satisfactory.

A small sum should always be available for the harbor to immediately repair any damage made to Long Beach by storms. These necessary repairs have averaged in the last twenty years $1,500.

Plymouth Harbor is in the collection district of Plymouth, Mass., of which Plymouth is the port of entry. The nearest light-houses are the Plymouth (Gurnet) lights, about 5 miles from Plymouth, and Duxbury Pier Light, about 2 miles distant.

Money statement.

July 1, 1896, balance unexpended	$4,988.67
June 30, 1897, amount expended during fiscal year	1,090.39
July 1, 1897, balance unexpended	3,898.28
July 1, 1897, outstanding liabilities	890.84
July 1, 1897, balance available	3,007.44

The dates and amounts of appropriations for this harbor are as follows:

Act of—		Act of—	
May 26, 1824	$20,000.00	June 23, 1874	$5,000.00
March 3, 1825	5,712.00	March 3, 1875	10,000.00
March 25, 1826	13,184.90	June 18, 1878	5,000.00
April 23, 1830	1,850.00	March 3, 1879	3,500.00
March 2, 1831	2,820.00	June 14, 1880	10,000.00
July 3, 1832	2,500.00	March 3, 1881	10,000.00
March 2, 1833	600.00	August 2, 1882	14,000.00
June 28, 1834	2,000.00	July 5, 1884	10,000.00
March 3, 1835	700.00	August 5, 1886	6,000.00
July 2, 1836	500.00	August 11, 1888	6,000.00
July 7, 1838	2,400.00	September 19, 1890	8,000.00
August 31, 1852	5,000.00	July 13, 1892	9,500.00
July 11, 1870	10,000.00	August 17, 1894	1,500.00
March 3, 1871	10,000.00	June 3, 1896	1,500.00
June 10, 1872	2,500.00		
March 3, 1873	3,000.00	Total	182,766.90

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The accompanying commercial statistics have been furnished by the collector of customs at Plymouth, Mass.

COMMERCIAL STATISTICS.

Amount of revenue collected, 1895, $6,947.39; 1896, $3,780.43; 1897, $1,750.26.

Shipping.	1895.		1896.		1897.	
	No.	Tons.	No.	Tons.	No.	Tons.
Entrances:						
Foreign	4	.....	6	.....	8	766
Domestic	83	.....	90	.....	.....	.....
Clearances:						
Foreign	5	.....	13	.....	9	1,071
Domestic	.....	.....	3	.....	.....	.....

Imported.	1895.	1896.	1897.
	Tons.	Tons.	Tons.
Coal	22,663	24,832	22,566
Iron	1,548	791	725
Lumber	a 2,600,000	a 1,400,000	a 3,400,000
Sand	165	160	320
Miscellaneous	.....	b 3,486	.....

a Feet. b Stone.

Barges and schooners of an average draft of 13 feet frequent the harbor.

B 15.

IMPROVEMENT OF HARBOR AT PROVINCETOWN, MASSACHUSETTS.

Provincetown Harbor is situated at the extremity of Cape Cod, about 40 miles southeast from Boston Light. It is one of the most valuable harbors of refuge on the Atlantic Coast. The entire commerce of New England and a very large local fishing interest are directly benefited by its maintenance, which depends entirely on the preservation of the sandy beaches which inclose it.

Since 1826 the project has been a general one, and provides for the preservation of the harbor by building dikes, bulkheads, and sand catches, and extensive planting of beach grass to repair or prevent storm damages to the beaches.

From the nature of the work it can at no time be considered completed.

A full history of the improvement will be found in the Annual Report of the Chief of Engineers for the years 1876, 1879, and 1886. A special dike across House Point Island Flats, to be built contingently, was recommended in the Annual Report for 1886.

A plan of the harbor was published in the Annual Report of the Chief of Engineers for 1886.

The total appropriations for this harbor to date are $155,918.44.

The amount expended to June 30, 1896, was $149,876.17.

The condition of the several works of preservation in this harbor on June 30, 1896, was as follows:

Long Point.—This long, narrow, low point forms the southeastern limit of the harbor. Works of preservation have been built at its northeastern end, protecting the Long Point light-house reservation, at a point near the Wood End Light, where the beach is exceedingly narrow and low, and at its northwestern end near Abel Hill. These works of protection were in good order.

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Abel Hill Dike.—This dike was built to prevent a rush of water from Lanceys Harbor over House Point Island Flats into the main harbor. The rapid wearing away of the southern sand spit that formed Lanceys Harbor had threatened to make a breach through the beach south of the dike. To guard against this, brush and wooden sand catches have been built on the outer beach opposite the west end of the dike. The dike was in good order.

House Point Island Flats.—These flats remained essentially unaltered. It still appears unnecessary to commence the dike projected to be built across these flats.

Beach Point, High Head Dike, and Cove Section.—These works were all in good order.

The river and harbor act of June 3, 1896, ordered a survey of the harbor "with a view of erecting a dike for the protection of that harbor."

This survey was made in October, 1896, and the plan and report of the survey were submitted to the Department March 1, 1897, and were published as House Doc. No. 8, Fifty-fifth Congress, first session.

The survey showed that no material alteration had occurred in House Point Island Flats; but continued weakening of the beach on the harbor side near Wood End Light was shown, and the report recommended the protection of the beach on the harbor side in that vicinity by means of a stone riprap estimated to cost $13,200.

No operations were in progress during the fiscal year. The works protecting the northeastern end of Long Point will soon require extension to the northwest, and additional works of protection are required near Wood End Light.

With these exceptions, the works of preservation at the date of this report are in good order and fulfilling satisfactorily the purpose for which they were built.

The nature of the works of preservation of the harbor requires a small sum to be always available for immediate repairs.

Such necessary repairs have averaged $1,500 per annum.

The prospective benefit to commerce is the preservation of an important harbor of refuge.

The accompanying commercial statistics have been furnished by the collector of customs at Barnstable, Mass.

Provincetown is a port of entry in the collection district of Barnstable, Mass. The nearest light-houses are Wood End and Long Point lights.

Money statement.

July 1, 1896, balance unexpended	$6,042.27
July 1, 1897, balance unexpended	6,042.27

The dates and amounts of the appropriations for this work are as follows:

Act of—		Act of—	
May 19, 1826	$3,500.00	August 14, 1876	$4,000.00
March 2, 1829	3,500.00	June 18, 1878	1,000.00
March 2, 1831	2,050.00	March 3, 1879	1,000.00
March 3, 1832	4,600.00	June 14, 1880	500.00
June 28, 1834	4,400.00	March 3, 1881	5,000.00
March 3, 1835	4,400.00	August 2, 1882	5,000.00
July 2, 1836	4,400.00	July 5, 1884	2,000.00
July 7, 1838	4,500.00	August 5, 1886	3,000.00
August 30, 1852	5,000.00	August 11, 1888	3,000.00
June 23, 1866	43,068.44	September 19, 1890	7,500.00
July 28, 1866	8,000.00	July 13, 1892	1,500.00
March 3, 1871	6,000.00	August 17, 1894	1,500.00
June 10, 1872	5,000.00	June 3, 1896	1,500.00
March 3, 1873	6,000.00		
June 23, 1874	6,000.00	Total	155,918.44
March 3, 1875	5,000.00		

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COMMERCIAL STATISTICS.

Amount of revenue collected, 1895, $308.82; 1896, $196.40; 1897, ——.

Shipping.	1895.		1896.		1897.	
	No.	Tons.	No.	Tons.	No.	Tons.
Entrances:						
Foreign	15	1,664	14	2,757	12	2,559
Domestic	5	590	7	810	5	708
Clearances:						
Foreign	16	1,532	12	1,246	9	1,025
Domestic	3	494	6	2,250	6	1,403

Imported.	1895.	1896.	1897.
	Tons.	*Tons.*	*Tons.*
Coal	5,600	6,000	5,500
Iron	45	40	35
Flour	a 3,000	a 2,900	a 2,700
Grain	600	575	600
Lumber	b 1,300,000	b 960,000	b 850,000
Salt	———	———	286
Tin	———	———	35
Wood	c 300	c 300	c 250
Merchandise	2,550	2,360	3,949

a Barrels. b Feet. c Cords.

All classes and nationalities of vessels visit the harbor for shelter or with cargo. Estimated value of vessels which enter the harbor during the year, $40,000,000.

B 16.

IMPROVEMENT OF HARBOR AT CHATHAM, MASSACHUSETTS.

Chatham Harbor is at the eastern end of Nantucket Sound, about 15 miles east of Hyannis, Mass. Its outer anchorage, known as Chatham Roads, is a capacious, deep, unobstructed harbor of refuge from northerly and easterly gales.

The inner harbor, locally known as "Stage" Harbor, is small but well landlocked. It is about one-half mile long, 500 to 600 feet wide, and has 8 to 12 feet depth at mean low water. Its entrance was originally obstructed by three bars, on which the depth at mean low water was not to exceed 4 feet. The mean rise or fall of the tide is 5 feet.

The project for the improvement of the inner harbor was submitted December 19, 1890, and was based on a survey made in October, 1890. It proposed to dredge a channel 6 feet deep at mean low water through the three obstructing bars, 100 feet wide at the inner bar, 150 feet wide at the middle bar, and 200 feet wide at the outer bar, at an estimated cost of $10,000.

The total appropriations to date have been $10,000.

The expenditures to June 30, 1896, were $4,402.15.

At that date the improved channel through the middle and inner bars was 100 feet wide, 6 feet deep at mean low water. Nothing had been done on the outer bar. At least 5 feet draft could be carried into the harbor at mean low water.

On June 20, 1896, a project was submitted for the expenditure of $5,000, appropriated by the river and harbor act of June 3, 1896.

The project was approved July 13, 1896, and on August 29, 1896, advertisement was published calling for bids for the proposed work to be opened on September 29, 1896.

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No bids were received in answer to this advertisement.

On March 24, 1897, a revised estimate of cost of the project was submitted, in accordance with Department letter 16423, August 7, 1896.

This estimate increased the cost of the improvement $3,732.79, the increase being necessary because of the small amount of work to be done and the distance of Chatham Harbor from large ports where dredging plants are maintained.

On May 19, 1897, it was recommended that the funds available for this work be retained in the Treasury until further funds are provided.

No other operations were in progress during the fiscal year, and at the date of this report the condition of the improvement is the same as on June 30, 1896.

Chatham Harbor is in the collection district of Barnstable, Mass., of which Barnstable is the port of entry. The nearest light-house is Hardings Beach light.

Money statement.

July 1, 1896, balance unexpended	$5,597.85
June 30, 1897, amount expended during fiscal year	23.95
July 1, 1897, balance unexpended	5,573.90
Amount (estimated) required for completion of existing project	3,732.79
Amount that can be profitably expended in fiscal year ending June 30,1899	3,732.79
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

The dates and amounts of appropriations for this harbor are as follows:

Act of—	
September 19, 1890	$5,000
June 3, 1896	5,000
Total	10,000

The accompanying commercial statistics have been furnished by the collector of customs at Barnstable, Mass.

COMMERCIAL STATISTICS.

Imported.	1895.	1896.	1897.
	Tons.	*Tons.*	*Tons.*
Coal	1,500	1,200	1,200
Lumber	37,000	12,000	20,000
Miscellaneous	25	*a* 5,000	*b* 2,000

a Bushels of oysters. *b* Bushels.

Vessels of all kinds drawing from 8 to 12 feet frequent the harbor, for shelter or with cargo.

B 17.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

On May 13, 1897, the wreck of the schooner *Annie E. Rudolph*, official number 106315, was reported to be such an obstruction to navigation as is contemplated by section 4 of the river and harbor act of June 14, 1880, and it was recommended that it be removed by the United States, at an estimated cost of $750.

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The wreck was about 2½ miles E. by N. of Orleans, Cape Cod, Massachusetts, in about 66 feet of water at low tide, and if the masts and spars were removed the hull would present no obstruction to navigation.

On May 20, 1897, an allotment of $750 was made for this work.

Proposals were invited by public advertisement dated June 10, 1897; bids to be received and opened July 10, 1897.

B 18.

PRELIMINARY EXAMINATION OF DUXBURY HARBOR, MASSACHUSETTS, WITH A VIEW TO WIDENING AND DEEPENING THE IMPROVEMENT.

[Printed in House Doc. No. 312, Fifty-fourth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., February 18, 1897.

SIR: I have the honor to submit the accompanying copy of report, dated February 15, 1897, by Lieut. Col. S. M. Mansfield, Corps of Engineers, concerning a preliminary examination of Duxbury Harbor, Massachusetts, with a view to widening and deepening the improvement provided for by the river and harbor act of June 3, 1896.

Colonel Mansfield is of the opinion, which is concurred in by me, that Duxbury Harbor is worthy of improvement by the General Government.

No survey is necessary for the preparation of plan and estimate of cost of improvement proposed.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. DANIEL S. LAMONT,
Secretary of War.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., February 15, 1897.

GENERAL: In accordance with directions contained in letter from your office dated June 16, 1896, I have the honor to submit the following report concerning a preliminary examination of Duxbury Harbor, Massachusetts, with view to widening and deepening improvement. With this object in view, I made a visit to the harbor and town of Duxbury on October 27, 1896.

From a report of a preliminary examination of this harbor made by Colonel Gillespie, Corps of Engineers, under date of November 8, 1886, published on page 472 of the Report of the Chief of Engineers for the year 1888, it appears that he considered at that time that "the harbor is worthy of improvement as one of the tributaries of the main harbor at Plymouth, Mass.," and in compliance with the provisions of the river and harbor act of August 5, 1886, he made a survey of the harbor and submitted a report, which was published, together with the map of the

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survey, in the same report of the Chief of Engineers, on page 473 et seq. I concur in the views therein expressed, and respectfully invite attention to these reports for a description of the harbor and of the improvement recommended.

So far as I am able to learn, it is my belief that no material change has occurred in the conditions since that time, save in the growth of the town and the increased importance of the demand for improvement, which will consist in excavating a channel 3,600 feet long, 60 feet wide, and 6 feet deep, in prolongation of "Western Branch" to the town wharf. * * *

Such an improvement will afford better shipping facilities than now exist, the difficulties of which are elaborated in the following communication of January 9, 1897, from the Duxbury Coal and Lumber Company:

DEAR SIR: I will, as briefly as possible, give you a few facts within my own personal knowledge of the growth of the town of Duxbury, the increase in the valuation of real estate along our shore, and the great need of an appropriation by Congress for the widening and deepening of our channel along the village shore.

Within four years the population of the town has increased more than one-third, the valuation of real estate (along the shore) over 300 per cent, and $75,000 invested in new wharves, piers, and private residences from Standish Hill to my wharf, which you will recognize on your chart in the survey made in 1888 under Colonel Gillespie as the town wharf. We have just completed a new wharf for our new yacht clubhouse, which is now in process of construction, and will be completed before April 1, 1897. Within two years I have rebuilt the old wharf (entirely new), at an expense of over $5,000; also a new hardware store and office, at $2,000, and am carrying an average stock of over $15,000. Have discharged at my wharf in the past year twelve cargoes of coal (four of which got stuck in the mud and had to be lightered at quite an expense and delay), eight cargoes of lumber, three of which got hung up in the same way as the coal, one cargo of bricks, and one cargo of lime.

We can not take in a vessel now drawing over 8 feet of water, and then only on high course tides; and, owing to the scarcity of these light-draft vessels (as they have practically gone out of the coal and lumber carrying trade), we have to pay from $1 to $1.35 per ton freight, when we should get same rates as Plymouth—60 to 70 cents per ton. This will give you some idea of the disadvantages under which we are laboring, all from the lack of a small appropriation by Congress for the dredging of the channel along the village shore, known as the western channel in the survey made under Colonel Gillespie in 1888.

* * * Our need of better shipping facilities has largely increased, and it seems almost imperative that something should be done at once toward the improvement of our harbor in order to keep up our commercial as well as other interests which we have started here.

I do not think there is a harbor along the whole south shore that is entitled to as much consideration at the present time as Duxbury Bay, and trust that upon careful investigation you will find our petition to be a just and needful one, and that your reprot may be favorable.

Yours, very truly,

JOHN A. IRWIN.

Lieut. Col. S. M. MANSFIELD,
Corps of Engineers, U. S. A.

I consider the harbor worthy of improvement by the General Government, and it is thought no additional survey is required to perfect the project.

Very respectfully, your obedient servant,

S. M. MANSFIELD,
Lieut. Col., Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

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B 19.

PRELIMINARY EXAMINATION OF DUXBURY BEACH, MASSACHUSETTS, WITH A VIEW TO THE PROTECTION OF THE HARBOR.

[Printed in House Doc. No. 313, Fifty-fourth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., February 18, 1897.

SIR: I have the honor to submit the accompanying copy of report, dated February 15, 1897, by Lieut. Col. S. M. Mansfield, Corps of Engineers, giving the results of a preliminary examination of Duxbury Beach, Massachusetts, with a view to the protection of the harbor, made to comply with the provisions of the river and harbor act of June 3, 1896.

For the reasons given, Colonel Mansfield is of the opinion, which is concurred in by me, that there is no necessity for strengthening the beach at present with a view of protecting the harbor of Duxbury.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. DANIEL S. LAMONT,
Secretary of War.

REPORT OF LIEUT. COL. S. M. MANSFIELD, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., February 15, 1897.

GENERAL: In accordance with directions contained in letter from your office dated June 16, 1896. I have the honor to submit the following report upon a preliminary examination of Duxbury Beach, Massachusetts, with a view to protection of harbor, made on the 29th of October, 1896.

Duxbury Beach is a long strip of land making out from the mainland at the northern extremity of Duxbury Bay, running to the southeastward and terminating at the head, upon which are the Gurnet Lights. It forms a barrier to bay and harbor of Duxbury against easterly storms in Massachusetts Bay. It is a string of sand dams, with intermediate low elevations, over which the seas occasionally wash, but no serious break in this barrier to the injury of the harbor has occurred or is to be feared. When a wash occurs it is soon filled again by natural causes, and any inroads of sand to the harbor are of no serious concern.

The Beach Channel, through which the tides ebb and flow to Back River, separates the beach from the Duxbury Harbor, which it is proposed to improve, and it is thought that there is no necessity of strengthening the beach at present with a view of protecting the harbor of Duxbury.

In my opinion it is unworthy of improvement by the General Government at the present time.

Very respectfully, your obedient servant,

S. M. MANSFIELD,
Lieut. Col., Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

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B 20.

PRELIMINARY EXAMINATION OF GURNET ROCK AND OTHER ROCKS AT MOUTH OF PLYMOUTH HARBOR, MASSACHUSETTS.

[Printed in House Doc. No. 314, Fifty-fourth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., February 18, 1897.

SIR: I have the honor to submit the accompanying copy of report, dated February 15, 1897, by Lieut. Col. S. M. Mansfield, Corps of Engineers, upon the results of a preliminary examination of Gurnet Rock and other rocks at mouth of Plymouth Harbor, Massachusetts, made to comply with the provisions of the river and harbor act of June 3, 1896.

For the reasons given Colonel Mansfield is of the opinion, which is concurred in by me, that work necessary to afford additional facilities to navigation at this locality is not worthy of being undertaken by the General Government.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. DANIEL S. LAMONT,
Secretary of War.

REPORT OF LIEUT. COL. S. M. MANSFIELD, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., February 15, 1897.

GENERAL: In accordance with directions contained in letter from your office dated June 16, 1896, I have the honor to submit the following report upon a preliminary examination of Gurnet Rock and other rocks at the mouth of Plymouth Harbor, Massachusetts.

An excellent opportunity was afforded me to examine this locality by accompanying the light-house inspector in his tender upon his visit to the Gurnet Lights on the 29th and 30th of September, 1896. I extract the following description of Gurnet and other rocks at the entrance to Plymouth Harbor from the Atlantic Coast Pilot:

> Gurnet Rock is a detached ledge with 4 feet at mean low water, lying a quarter of a mile southeast by east three-fourths east from Gurnet Point, and on the northern side of the channel. It is marked with a buoy placed in 18 feet of water on the eastern side, and between them is another rock with 9 feet at low water.
>
> On the northern side of the channel, about 800 yards southwest by west one-half west from Gurnet Rock buoy, is a red spar buoy marking Bass Rock, upon which is 4 feet at low water and bears from Gurnet Point light-houses south one-half west, distant a little over 500 yards. The buoy is in 15 feet of water on the southern side of the rock.

There is no record of disasters on these rocks, and from all I am able to learn they offer no serious danger to navigation. I am therefore of opinion that they are not worthy of improvement by the General Government.

Very respectfully, your obedient servant,

S. M. MANSFIELD,
Lieut. Col., Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers U. S. A.

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B 21.

PRELIMINARY EXAMINATION OF THE APPROACHES TO THE CAPE COD SHIP CANAL, MASSACHUSETTS.

[Printed in House Doc. No. 311, Fifty-fourth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., February 19, 1897.

SIR: I have the honor to submit the accompanying copy of report, dated February 16, 1897, by Lieut. Col. S. M. Mansfield, Corps of Engineers, concerning a preliminary examination of "The approaches to the Cape Cod Ship Canal," Massachusetts, provided for by the terms of the river and harbor act of June 3, 1896.

It appears from Colonel Mansfield's report that there is no Cape Cod Ship Canal, and no charter in existence for the construction of one, and that its location, if such a waterway is ever opened, can only be conjectured. Under these circumstances it is impossible to state whether or not the approaches to such a canal would be work worthy to be undertaken by the General Government, but under present conditions action by the United States in the matter does not seem judicious.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. DANIEL S. LAMONT,
Secretary of War.

REPORT OF LIEUT. COL. S. M. MANSFIELD, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., February 16, 1897.

GENERAL: In accordance with directions contained in letter from your office dated June 16, 1896, I have the honor to submit the following report concerning a preliminary examination of the approaches to the Cape Cod Ship Canal, Massachusetts.

Since the last of a series of charters for the construction of a canal across Cape Cod has been forfeited by the failure of the late company to comply with the provisions of its charter, it would appear that there is no immediate prospect of such a work being constructed. The location of a canal, except within certain limits, can only be conjectured, but the approaches thereto will doubtless be through Buzzards Bay and Barnstable Bay, and they have been examined and surveyed to cover the entrances for the proposed Cape Cod Canal. Reference is invited to a very elaborate report upon the examination and survey made by Lieut. Col. G. K. Warren, and published in the Report of the Chief of Engineers for 1882, pages 579 et seq.

For the above reason and since there is no Cape Cod Ship Canal, and no charter in existence for the construction of one, I am of the opinion that the approaches at the present time are unworthy of improvement by the General Government.

Very respectfully, your obedient servant,

S. M. MANSFIELD,
Lieut. Col., Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

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B 22.

ESTIMATE OF COST OF IMPROVING MERRIMAC RIVER, MASSACHUSETTS, BY DREDGING CHANNEL THEREOF BETWEEN NEWBURYPORT AND HAVERHILL.

[Printed in House Doc. No. 52, Fifty-fifth Congress, first session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., May 11, 1897.

SIR: I have the honor to submit the accompanying report, dated May 5, 1897, by Lieut. Col. S. M. Mansfield, Corps of Engineers, with estimate of cost of improving the Merrimac River, Massachusetts, by dredging the channel thereof between Newburyport and Haverhill of the width of 150 feet and of the depth of 7 feet at mean low water, made to comply with the requirements of the river and harbor act of June 3, 1896.

Lieutenant-Colonel Mansfield states that under previous appropriations this section of the Merrimac has been improved at Rock Bridge, Curriers Shoal, both ends of Silbys Island, and between the bridges at Haverhill, and that the depth required renders improvement necessary only at the above-mentioned localities and at additional points, as follows: A small shoal about midway between the mouth of Powow River and Rock Bridge; about 3,500 feet of channel between Rock Bridge and Curriers Shoal, and a small shoal about midway between Curriers Shoal and Groveland Bridge.

The cost of this work, including contingencies, is estimated to be $171,442.70.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF LIEUT. COL. S. M. MANSFIELD, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., May 5, 1897.

GENERAL: Under the following provision contained in the river and harbor act of June 3, 1896, viz:

For the improvement of the channel of the Merrimac River, Massachusetts, by removing certain rocks therein below Rock Bridge, $5,000. The Secretary of War is directed to furnish to the House of Representatives an estimate of the cost of improving the Merrimac River, Massachusetts, by dredging the channel thereof between Newburyport and Haverhill of the width of 150 feet and of the depth of 7 feet at mean low water, provided the estimate can be furnished from surveys already made—

I have the honor to submit the following report and estimate:

Between Newburyport and Haverhill the Merrimac River has been improved, under previous appropriations, at Rock Bridge, Curriers Shoal, both ends of Silbys Island, and between the bridges at Haverhill.

The location and width of the channel upon which the accompanying estimate is based is laid down upon the map accompanying my report to the Chief of Engineers, under date of January 15, 1896, upon the

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resurvey of Merrimac River, but the change in the depth required, from 12 feet to 7 feet at mean low water, renders improvement necessary only at the localities above enumerated, and at additional points as follows: A small shoal about midway between the mouth of Powow River and Rock Bridge, about 3,500 feet of channel between Rock Bridge and Curriers Shoal, and a small shoal about midway between Curriers Shoal and Groveland Bridge.

At all these localities, excepting Rock Bridge and between the bridges at Haverhill, the material to be excavated consists of mud, sand, gravel, and clay.

At Rock Bridge the bottom consists of a mass of bowlders, embedded in soft material, and can be removed by dredging to the required grade.

At Haverhill, between the bridges, ledge in large quantity underlies the channel bottom and will require drilling and blasting.

The disposition of excavated material adds greatly to the cost of the work, as all material must be rehandled if deposited on the banks of the river, and if towed to sea and dumped the length of tow would average 15 miles.

ESTIMATE.

Dredging 105,892 cubic yards (scow measurement) of mud, sand, gravel, and clay, at 50 cents per cubic yard	$52,946.00
Dredging 9,733 cubic yards of bowlders, at $2 per cubic yard	19,466.00
Removing 5,563 cubic yards of ledge, at $15 per cubic yard	83,445.00
	155,857.00
Engineering expenses and contingencies, 10 per cent	15,585.70
Total	171,442.70

Very respectfully, your obedient servant,

S. M. MANSFIELD,
Lieut. Col., Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

B 23.

SURVEY OF MANCHESTER HARBOR, MASSACHUSETTS, WITH A VIEW OF SECURING A CHANNEL 8 FEET DEEP AT MEAN LOW WATER, 200 FEET WIDE AT THE ENTRANCE, AND 150 FEET WIDE AT AND ABOVE PROCTORS POINT TO THE TOWN LANDING.

[Printed in House Doc. No. 29, Fifty-fifth Congress, first session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., April 17, 1897.

SIR: The river and harbor act of June 3, 1896, in the item in section 1 respecting Manchester Harbor, Massachusetts, directs the Secretary of War "to cause a survey and estimate of cost of improvement to be made, with a view of straightening the channel between the mouth of Manchester Harbor and Proctors Point, removing obstructions at the mouth of the channel and at the point of rocks, dredging the channel for its entire length between its mouth and the town wharf to a width of from two hundred feet, narrowing to one hundred and fifty feet, and a depth of eight feet, and providing turning basins and anchorage for boats by the dredging of the flats for that purpose;" and section 9 of

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the aforesaid act also directs the Secretary of War, at his discretion, to cause a survey to be made at Manchester Harbor, and the cost of improvement thereat to be estimated.

The duty of making the survey provided for in the two sections of the act referred to was assigned to the charge of Lieut. Col. S. M. Mansfield, Corps of Engineers, and I now have the honor to submit his report, dated April 7, 1897, with map,* upon the subject.

The plan of improvement presented contemplates securing a channel 8 feet deep at mean low water, 200 feet wide at the harbor entrance, and 150 feet wide at and above Proctors Point to the town landing. The cost is estimated at $139,966.09.

In transmitting the report to this office Colonel Mansfield stated as follows:

It is my opinion that the cost of the proposed improvement is out of proportion to the benefits to be derived, and therefore unworthy, and the same is not justified by the interests of commerce involved.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF LIEUT. COL. S. M. MANSFIELD, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., April 7, 1897.

GENERAL: In accordance with instructions of September 5, 1896, I have the honor to submit the following report (accompanied with a tracing) of the survey of Manchester Harbor, Massachusetts, as provided for in the river and harbor act of June, 3, 1896:

The first section of this act contains the following item, which clearly defines the purpose of the survey, viz:

Manchester Harbor, Massachusetts: The Secretary of War is directed, out of the appropriation on hand, to cause a survey and estimate of cost of improvement to be made, with a view of straightening the channel between the mouth of Manchester Harbor and Proctors Point, removing obstructions at the mouth of the channel and at the point of rocks, dredging the channel for its entire length between its mouth and the town wharf to a width of from two hundred feet, narrowing to one hundred and fifty feet, and a depth of eight feet, and providing turning basins and anchorage for boats by the dredging of the flats for that purpose.

A survey of this harbor was made by this office in 1887, and a project was submitted for a channel 60 feet wide and 4 feet deep at mean low water from Proctors Point to the town wharves. This project was completed in 1894, at a cost of $14,300.

The information furnished by the survey of 1887 was sufficient, so far as it went, to base an estimate of cost of the prospective project of improvement, but it did not extend far enough seaward or define sufficiently the ledges in the vicinity of Proctors Point and in "The Narrows" to furnish the necessary information on which to estimate for a so greatly increased width and depth of channel as is now called for.

The operations of the present survey were confined to securing this necessary information.

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*Not reprinted. Printed in House Doc. No. 29, Fifty-fifth Congress, first session.

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The shore lines shown upon the map are taken from the United States Coast Survey map of 1851, with additions and corrections of wharves and piers to date.

Six triangulation stations were established, from which ranges for soundings were laid out and soundings intersected with a transit. One hundred and seventy-six lines were run, on which 5,061 soundings were taken, 2,093 of which were located by intersecting angles. To determine the location and extent of ledge underlying the bed of the channel, 1,526 borings were made, all to a depth of at least 8 feet below mean low water. Five hundred and seventy of these borings were made in "The Narrows," 857 on Bow Bell Ledge and over the ledges off Proctors Point, and 99 across the flats extending easterly from Glass Head.

The mean rise or fall of the tide is 9 feet.

The bench mark is the top of steel rails on the Boston and Maine Railroad Bridge draw, and is 16.13 feet above mean low water.

The entrance to Manchester Harbor is from Massachusetts Bay through the main ship channel leading to Salem Harbor, which it leaves one-fourth of a mile west of Bakers Island lights; thence for 1 mile it leads almost due north, to the center of the roadstead, where there is an anchorage three-fourths of a mile square, with a greatest depth of 6 fathoms at mean low water.

Following the natural channel of entrance, the distance from the roadstead to the town landing is about 7,500 feet.

This channel is entered from the roadstead on about a northeast course, and after running about 800 feet it sweeps through east, around flats extending easterly from Glass Head, in approximately the arc of a circle with a radius of about 750 feet through about 180° to Proctors Point, 3,000 feet from the entrance.

To this point there is a navigable channel about 75 feet wide between the 6-foot contours, obstructed at the mouth by a few small shoals.

At Proctors Point the channel is encroached upon by extensive ledges on the Proctors Point side and is further obstructed by Bow Bell Ledge on the westerly side. The channel swings around this point on a curve of about 300 feet radius through about 100°, and the depth of water in the channel gradually reduces to 4 feet northwest of Proctors Point, where the channel dredged by the United States to a width of 60 feet and depth of 4 feet at mean low water commences, and extends for 4,000 feet to the town wharves.

This channel is crossed at a point about 1,000 feet below the town landing by the Boston and Maine Railroad Bridge, with a draw opening 27.9 feet in the clear.

The entrance channel from the roadstead to northwest of Proctors Point, 3,500 feet in length, would require extensive excavation throughout its entire length if it were to be made 8 feet deep and from 200 to 150 feet wide, and should it be so improved the difficult curve around Proctors Point would still exist.

With this difficulty evident, an examination of the flats encircled by the outer channel was made to determine the practicability of cutting a straight channel from the entrance to Proctors Point. Ninety-nine borings were made across these flats, showing the material to be mud and sand to a depth of about 6 feet below low water and below that clay to a depth of 8 feet. No ledge was found, and a cut 200 feet wide at the outer end and 150 feet wide northwest of Proctors Point and 2,500 feet long can be made, thus eliminating the curves which render the channel particularly difficult to navigate, at probably no greater cost than to improve the 3,500 feet of natural channel up to the same point.

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The survey of the ledges off Proctors Point shows that it is impossible to dredge a channel 150 feet wide at this point without ledge excavation.

The ledges off Proctors Point are extensive, and on the west side of the channel one large ledge, known as Bow Bell, exists, but by means of a slight reverse curve, through which a straight course can be run, a channel 150 feet wide can be obtained between these ledges, cutting off Proctors Point and a part of the Bow Bell Ledge, thus reducing the ledge excavation to a minimum.

The survey of "The Narrows" shows that a channel 150 feet wide can be excavated to a depth of 8 feet without encountering ledge, the material found down to that depth being sand and mud.

The material which would be excavated in all other parts of the harbor covered by the project is sand and mud.

Estimate for channel 200 feet wide at entrance, 150 feet wide at Proctors Point and therefrom to the town landing, 8 feet deep at mean low water.

Dredging 377,473 cubic yards of mud, sand, and clay, at 30 cents per cubic yard	$113,241.90
Removing 1,400 cubic yards of ledge, at $10 per cubic yard	14,000.00
	127,241.90
Engineering expenses and contingencies, 10 per cent	12,724.19
Total	139,966.09

Total length of channel, 7,500 feet.

Respectfully submitted.

S. M. MANSFIELD,
Lieut. Col., Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

B 24.

SURVEY OF MANCHESTER HARBOR, MASSACHUSETTS.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., July 30, 1897.

GENERAL: I have the honor to submit the following report upon a survey of Manchester Harbor, Massachusetts, as provided in section 9 of the river and harbor act of June 3, 1897.

Section 1 of this act directs that a survey and estimate of cost of improvement of Manchester Harbor be made with a view of straightening the channel, dredging the same to certain specified width and depth, and providing turning basins and anchorage for boats by dredging the flats for that purpose.

A survey, with a report and estimate of cost of improvement in accordance therewith, was submitted April 7, 1897, and in transmitting the same to the Department I expressed the opinion that the cost of the proposed improvement is out of proportion to the benefits to be derived and therefore unworthy, and the same is not justified by the interests of commerce involved.

Under instructions contained in Department letter of June 30, 1897, I present for the consideration of Congress the following plan and esti-

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mate of an improvement which I consider to be justified by the interests of commerce, viz:

Following the natural channel heretofore under improvement I propose to dredge the same to a depth of 6 feet at mean low water for a length of 7,200 feet, to make it 100 feet wide at the entrance and at the sharp bends, and at least 75 feet wide throughout, with two turning or anchorage basins, one 200 feet by 300 feet in area just below the bridge, and the other 125 feet by 250 feet near the town landing wharf, as shown upon the accompanying tracing. This will cost for—

Dredging 76,176 cubic yards of mud, sand, and clay, at 30 cents per cubic yard	$22,852.80
Contingencies and engineering expenses	2,147.20
Total	25,000.00

Respectfully submitted.

S. M. MANSFIELD,
Lieut. Col., Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

B 25.

SURVEY OF MARBLEHEAD HARBOR, MASSACHUSETTS, WITH A VIEW TO IMPROVING THE HARBOR BY BUILDING A SEA WALL TO PROTECT THE ISTHMUS CONNECTING MARBLEHEAD NECK WITH THE TOWN OF MARBLEHEAD.

[Printed in House Doc. No. 289, Fifty-fourth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., February 11, 1897.

SIR: I have the honor to submit the accompanying copy of report of February 4, 1897, with map,* by Lieut. Col. S. M. Mansfield, Corps of Engineers, upon the results of a survey of Marblehead Harbor, Massachusetts, with a view to improving the harbor by building a sea wall to protect the isthmus connecting Marblehead Neck with the town of Marblehead, made to comply with the requirements of the river and harbor act of June 3, 1896.

Colonel Mansfield is of the opinion that there is no danger of the sea making a breach in the isthmus to the injury of the harbor.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. DANIEL S. LAMONT,
Secretary of War.

REPORT OF LIEUT. COL. S. M. MANSFIELD, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., February 4, 1897.

GENERAL: Under the provision of section 9 of the river and harbor act of June 3, 1896, and instructions contained in Department letter

*Not reprinted. Printed in House Doc. No. 289, Fifty-fourth Congress, second session.

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dated September 5, 1896, I have the honor to submit herewith a tracing showing Marblehead Harbor, together with a survey in detail of the isthmus connecting Marblehead Neck (sic) with the town of Marblehead, made under my direction in September, 1896.

Marblehead Harbor is about 12 miles north of Boston, Mass., well sheltered on the west by the mainland, on the east by Marblehead Neck, and on the south by the narrow connecting isthmus, and is entered from the north. It embraces an area of about 200 acres, of a depth of 12 feet and over and has little or no commercial importance, but is a headquarters for yatching interests, for which it is most admirably adapted.

The isthmus is 2,000 feet long, of an average width of 125 feet between high-water lines, and its least width 105 feet. Its southern beach is exposed to the full sweep of the ocean from the southeast, but is not materially affected thereby. The maximum height of crest is 20.86 feet, the maximum height 17.92 feet above mean low water.

For about 1,900 feet of its length, from A to E on the plan, it is protected by a stone wall reported to have been built by the United States Government early in the present century; its outlines are well defined in the sections shown on the plan by cross shading from B to C and from D to E. Between A and B it is covered by a drift of sand upon which is now a growth of beach grass, and between C and D it is buried under coarse gravel. This wall forms the backbone of the isthmus; the exposed section from B to C is about 16 feet wide, formed of two parallel dry rubblestone walls with the intervening space filled with cobblestones and gravel. It is reinforced by a highway along its northerly side, built of clay and stone, about 30 feet in width and faced on the northerly side by a substantial dry rubblestone wall with its top in about grade 16 feet above mean low water. It is in good condition, and the uniform weatherworn condition of the hand rail and supports which surmount it indicates that it has stood for many years unaffected by the sea.

Cross sections through the narrowest parts of the isthmus are developed on the accompanying plan.

There is no record in this office of any former survey having been made here, but such comparison as can be made of this survey with the records of an examination made in 1884 indicates that the condition of the isthmus has not materially changed since that time.

The act of June 3, 1896, provides for this survey "with a view to improving the harbor by building a sea wall to protect the isthmus," and for an estimate of the cost of the improvement.

There appears to be no local demand for the improvement of the harbor, and it is difficult to conceive of how it could be improved, and therefore no estimate of cost is submitted.

Under date of July 13, 1889, I had the honor to report to the Department as follows:

> After a careful examination of the neck of land at the head of Marblehead Bay, I am satisfied that there is not the least prospect of the sea ever making a breach in it to the injury of the harbor. Any extension of the wall along it would only be of benefit to the highway, in which the Government has no special interest.

I see no reason now to change this opinion.

Very respectfully, your obedient servant,

S. M. MANSFIELD,
Lieut. Col., Corps of Engineers.

The CHIEF OF ENGINEERS,
United States Army.

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B 26.

SURVEY OF LYNN HARBOR, MASSACHUSETTS, WITH A VIEW TO SECURING A CHANNEL 300 FEET WIDE AND 15 FEET DEEP AT LOW WATER.

[Printed in House Doc. No. 28, Fifty-fifth Congress, first session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., April 14, 1897.

SIR: I have the honor to submit the accompanying copy of report, dated March 29, 1897, with map,* by Lieut. Col. S. M. Mansfield, Corps of Engineers, giving the results of a survey of Lynn Harbor, Massachusetts, with a view to securing a channel 300 feet wide and 15 feet deep at low water, made to comply with the provisions of the river and harbor act of June 3, 1896.

This harbor is now being improved by the General Government, the existing project providing for the dredging of a channel through the outer and inner bars 200 feet wide and 10 feet deep at mean low water, for the building of a training wall, if necessary, to keep the outer channel open, for ocassional dredging of the inner channel, and for the extension of the inner channel 400 feet within the harbor line, and to excavate at its inner end a basin 500 by 300 feet in area, 10 feet deep at mean low water. Up to the present time the necessity for the training wall has not been apparent, as the improved channel has held fairly well to the dimensions dredged.

A contract has been authorized for completing the existing project under the provisions of the river and harbor act of June 3, 1896, appropriating $20,000 for the improvement of this harbor, and the work of dredging will be completed this season.

The plan submitted by Colonel Mansfield for securing a channel 300 feet wide and 15 feet deep at mean low water contemplates the dredging of the outer and inner channels and the construction of the training wall. The cost of the proposed work is estimated at $441,813.07.

In transmitting the report to this office Colonel Mansfield stated as follows:

> The large expenditure required to execute the improvement called for is scarcely justified by the interests of commerce involved. By reference to my last annual report it will be seen that during the past three years there has been a steady and comparatively large increase in the commerce of the port, and because of complaints of the insufficiency of depth of water and consequent grounding of vessels, I am of opinion that the harbor is worthy of improvement to a certain extent, but not to the degree called for.
>
> The great cost of the proposed improvement is due to the widening of the present 200-foot channel to 300 feet.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF LIEUT. COL. S. M. MANSFIELD, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., March 29, 1897.

GENERAL: In compliance with instructions of September 5, 1896, I have the honor to submit the following report (accompanied with a

* Not reprinted. Printed in House Doc. No. 28, Fifty-fifth Congress, first session.

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tracing) of the survey of Lynn Harbor, Massachusetts, with a view to securing a channel 300 feet wide and 15 feet deep at low water, as provided for in the river and harbor act of June 3, 1896.

The accompanying chart of the harbor is compiled from surveys made by the United States engineers in the development of the harbor improvements heretofore made, and a survey of the entrance to the harbor made under provisions of this act September 5 to 16, 1896, and is based upon an extended survey made under the direction of Maj. C. W. Raymond, Corps of Engineers, in 1883. It correctly exhibits the present condition of the harbor and offers ample data for developing the proposed channel and estimating the cost thereof.

At present the channel shown upon this chart has a width of 200 feet and depth of 10 feet at mean low water, except for a distance of about 2,000 feet at its inner end where the width is only 150 feet. A contract is now authorized for completing the project under the provision of the act of June 3, 1896, appropriating $20,000 for continuing the improvement, and the work of dredging will be completed this season.

The provision for a training wall is in force, but up to the present time its necessity has not been apparent, for the improved channel has held fairly well to the dimensions dredged. It is not unlikely, however, that when the channel is enlarged to the dimensions proposed, the necessity for the training wall may be urgent, and on the tracing I have slightly modified its position to conform to the new conditions.

The estimate for a channel 300 feet wide and 15 feet deep at mean low water is to dredge from the—

Outer channel....	350,712 cubic yards in scows.	
Inner channel....	993,933 cubic yards in scows.	
Total.....	1,344,645 cubic yards, at 25 cents per cubic yard....	$336,161.25
For training wall (estimated by The Board of Engineers in 1884).....		65,487.00
		401,648.25
Engineering expenses and contingencies, 10 per cent.....		40,164.82
Total.....		441,813.07

Respectfully submitted.

S. M. MANSFIELD,
Lieut. Col., Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

B 27.

SURVEY OF WEYMOUTH (BACK) RIVER, MASSACHUSETTS, FROM HINGHAM BRIDGE TO MANN'S WHARF.

[Printed in House Doc. No. 12, Fifty-fifth Congress, first session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., March 22, 1897.

SIR: I have the honor to submit the accompanying copy of report, dated March 15, 1897, with map,* by Lieut. Col. S. M. Mansfield, Corps of Engineers, upon the results of a survey of Weymouth (Back) River,

* Not reprinted. Printed in House Doc. No. 12, Fifty-fifth Congress, first session.

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Massachusetts, from Hingham Bridge to Mann's wharf, made to comply with the provisions of the river and harbor act of June 3, 1896.

Colonel Mansfield states that no preliminary examination or report has previously been made concerning this portion of the Weymouth River; that the shoal water limits navigation to a very small class of vessels, and to the period of high water; and that no commerce of any importance exists at present.

The plan of improvement submitted provides for obtaining a channel 60 feet wide and 4 feet deep, with a view to accommodating the transportation of coal and building materials up to Mann's wharf. The proposed work is estimated to cost $49,834.01.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF LIEUT. COL. S. M. MANSFIELD, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., March 15, 1897.

GENERAL: I have the honor to submit the following report of a survey of Weymouth (Back) River, from Hingham Bridge to Mann's wharf, Massachusetts, with an estimate of the cost of improvement, made in compliance with the requirements of section 9 of the river and harbor act of June 3, and with your instructions of September 5, 1896.

Weymouth (Back) River empties into Hingham Bay, Boston Harbor, Massachusetts. The lower portion of the river was surveyed in 1890, and a project for improving the channel up to the Bradley Fertilizer Company's wharf was submitted by me February 7, 1891.

The section of the river covered by the present survey extends the former survey through Hingham Bridge to Mann's wharf, a distance of about 2¾ miles. A base line 827 feet long was measured, and 21 triangulation stations established in a system on the banks of the river and connected with the triangulation of 1890.

One hundred and seven ranges for sounding were laid out from the triangulation stations and 7,828 soundings were taken, 894 of which were intersected with a transit.

The soundings on the plan are selected from those taken in the survey. They are expressed in feet and tenths, and are referred to the plane of mean low water of Boston Lower Harbor.

The bench mark used was established for the survey of 1890, and is defined by three iron spikes driven in the side of the corner pile at the west end of the outer face of the Bradley Fertilizer Company's wharf, 10 feet above mean low water.

The mean rise or fall of the tide is 9.4 feet.

At the present time 6 feet draft can be carried at mean low water from the mouth of the river to the Bradley Fertilizer Company's wharf, in a channel of a least width of 150 feet; and the approved project of improvement provides for a channel 200 feet wide and 12 feet deep at mean low water to this wharf, and is now under contract.

Opposite the upper end of this wharf the river is obstructed by a bar which contracts the channel to a width of 35 feet between the 6-foot contours for a distance of 75 feet, where it again widens to ample navigable width and extends up the river about 3,700 feet to a point 950

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feet below Hingham Bridge, from which point to the bridge the channel rapidly shoals to a least depth of 0.4 foot in the draw.

Above the bridge the channel has a greatest continuous depth of 2.5 feet and least width between mean low-water contours of 80 feet for a distance of about 2,000 feet, where it develops into a series of three deep holes in which the greatest depth found was 36.5 feet and embracing a length of channel of about 2,500 feet. Above these holes no navigable low-water channel exists for a distance of 6,500 feet to Mann's wharf, where but 6.4 feet at mean high water can be carried.

No borings were made to determine the character of material in the bed of the river, as it was not deemed necessary. In the event of improvement gravel will be found in the vicinity of Hingham Bridge and soft mud in the upper part of the river.

The clear width of opening in the draw of Hingham Bridge is 24.5 feet.

The topography and hydrography of the river below the Bradley Fertilizer Company's wharf shown on the plan was taken from the survey made by this office in 1890.

No preliminary examination or report has ever been made upon this portion of the river. The shoal water limits navigation to a very small class of vessels, and to the period of high water. No commerce of any importance exists, but to make an improvement of the river to accommodate the transportation of coal and building materials to Mann's wharf, I suggest a channel be made 60 feet wide and 4 feet deep; this will require the removal of—

129,439 cubic yards of gravel and mud in scows, which, at 35 cents per cubic yard, will cost	$45,303.65
Add for contingencies	4,530.36
Total	49,834.01

	Feet.
Length of section at Hingham Bridge	2,400
Length from deep holes to Mann's wharf	6,400
Total length	8,800

	Yards.
Amount of dredging at Hingham Bridge	7,377
Amount of dredging from deep holes to Mann's wharf	122,062
Total yards	129,439

Respectfully submitted.

S. M. MANSFIELD,
Lieut. Col., Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

B 28.

SURVEY OF NEPONSET RIVER, MASSACHUSETTS.

[Printed in House Doc. No. 36, Fifty-fifth Congress, first session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., April 22, 1897.

SIR: I have the honor to submit the accompanying copy of report, dated April 17, 1897, with map,* by Lieut. Col. S. M. Mansfield, Corps

*Not reprinted. Printed in House Doc. No. 36, Fifty-fifth Congress, first session.

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of Engineers, concerning a survey of Neponset River, Massachusetts, provided for by the terms of the river and harbor act of June 3, 1896.

The project of improvement presented provides for dredging the natural channel of the river so as to secure a depth of 10 feet at mean low water, with width of 150 feet from the mouth to the railroad bridge at Neponset; thence 100 feet wide to the Neponset Highway Bridge; 100 feet wide and 6 feet deep thence to the Granite Bridge; at least 75 feet wide thence to the southerly corner of Godfrey's coal wharf in Milton; and 50 feet wide for a farther distance of 250 feet. The cost is estimated at $35,000.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF LIEUT. COL. S. M. MANSFIELD, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., April 17, 1897.

GENERAL: In accordance with instructions of September 5, 1896, I have the honor to submit the following report (accompanied with a tracing) of the survey of Neponset River, Massachusetts, as provided for in the river and harbor act of June 3, 1896:

I had the honor to report upon the preliminary examination of this river October 31, 1892, and in connection with the present report I would respectfully invite attention thereto for my reasons why this river is worthy of improvement by the General Government. Said report is published in the Report of the Chief of Engineers for 1893, page 800.

The improvement of this river will benefit the large coal and lumber interests located about its mouth, and improve the facilities for reaching the wharves just below the dam at Dorchester Lower Mills.

At the present time 7 feet draft can be carried at mean low water from the mouth to Neponset Bridge, and about 3 feet to the head of navigation at the New York, New Haven and Hartford (Shawmut Branch) Bridge. The rise and fall of the tide is 10 feet.

Three bridges cross the river, with draw openings of 36 feet in the clear.

The chart submitted is compiled from United States coast and geodetic surveys, the hydrography having been executed in 1892–93, and the wharves and bridges are corrected to date. The plan fairly represents the actual conditions, and affords sufficient data for making a project of improvement and for estimating its cost.

PROJECT.

I recommend the improvement of the natural channel of the river so that it shall be 10 feet deep at mean low water for 150 feet in width, from the mouth to the railroad bridge at Neponset; thence to the Neponset Highway Bridge, 100 feet wide; between this latter and Granite Bridge, a distance of 6,150 feet, I would make it 100 feet wide and 6 feet deep; thence for a distance of 6,800 feet at least 75 feet wide to the southerly corner of Godfrey's coal wharf in Milton, and 50 feet wide for a farther distance of 250 feet.

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Estimate.

Dredging 106,885 cubic yards in scows, at 30 cents per cubic yard	$32,065.50
Contingencies and engineering expenses	2,934.50
Total	35,000.00

Respectfully submitted.

S. M. MANSFIELD,
Lieut. Col., Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

B 29.

SURVEY OF HARBOR AT PLYMOUTH, MASSACHUSETTS.

[Printed in House Doc. No. 39, Fifty-fifth Congress, first session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., April 29, 1897.

SIR: I have the honor to submit the accompanying report of April 24, 1897, with map,* by Lieut. Col. S. M. Mansfield, Corps of Engineers, of the results of a survey of harbor at Plymouth, Mass., made to comply with the requirements of the river and harbor act of June 3, 1896.

Plymouth Harbor has heretofore been improved to the extent of providing a channel from the outer anchorage (Cow Yard), 150 feet wide and 9 feet deep, mean low water, with a turning basin in front of the town wharves 866 feet long and 150 feet wide.

The further improvement proposed by Colonel Mansfield is to provide, in the vicinity of the Middle Ground or Splitting Knife Shoals, where a sharp turn occurs, a channel 250 feet wide and 9 feet deep at mean low water to facilitate navigation, and to redredge the basin, all at an estimated cost, including contingencies, of $8,716.95.

In transmitting this report Colonel Mansfield states that in his opinion the harbor is worthy of improvement, and the expense is justified by the interests of commerce involved.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF LIEUT. COL. S. M. MANSFIELD, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., April 24, 1897.

GENERAL: In accordance with instructions of September 5, 1896, I have the honor to submit the following report (with a plan) upon the survey of Plymouth Harbor, Massachusetts, as provided for in the river and harbor act of June 3, 1896.

Plymouth Harbor has heretofore been improved to the extent of pro-

* Not reprinted. Printed in House Doc. No. 39, Fifty-fifth Congress, first session.

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viding a channel from the outer anchorage (Cow Yard), which is a common anchorage ground for Plymouth, Kingston, and Duxbury, 150 feet wide and 9 feet deep, mean low water, with a turning basin in front of the town wharves 866 feet long and 150 feet wide.

In my preliminary examination report, submitted October 29, 1894, and which is published in the Annual Report of the Chief of Engineers for the year 1895, page 646, it is stated that the then condition of the harbor and dredged channel is only fairly satisfactory. The removal of the Middle Ground, which is a serious obstruction, and a portion of the Splitting Knife Shoals to ease the sharp bend from the main channel at the entrance to the dredged channel will result in a great improvement. It has been found that the silt and sewage brought down by Town Creek empties directly into the dredged basin and has caused some shoaling, and this deposit must be periodically removed, if the depth of 9 feet is to be maintained. Such a shoaling has once been removed since the basin was dredged, and further dredging is now required.

No change is apparent in the position and dimension of the Middle Ground or Splitting Knife Shoals, or of the bar at the east end of the Middle Ground, and it is proposed to provide in this vicinity, where a sharp turn occurs, a channel 250 feet wide and 9 feet deep at mean low water to facilitate navigation, and this will necessitate the removal from a portion of each of the shoals and of the bar at the east end of the Middle Ground of—

19,082 cubic yards, at 30 cents per cubic yard	$5,724.60
For redredging the basin, 7,333 cubic yards, at 30 cents per cubic yard	2,199.90
	7,924.50
Engineering expenses and contingencies, 10 per cent	792.45
Total	8,716.95

Respectfully submitted.

S. M. MANSFIELD,
Lieut. Col., Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

B 30.

SURVEY OF PROVINCETOWN HARBOR, MASSACHUSETTS, WITH A VIEW OF ERECTING A DIKE FOR THE PROTECTION OF THAT HARBOR.

[Printed in House Doc. No. 8, Fifty-fifth Congress, first session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., March 10, 1897.

SIR: I have the honor to submit the accompanying copy of report, dated March 1, 1897, with map,* by Lieut. Col. S. M. Mansfield, Corps of Engineers, of the results of a survey of Provincetown Harbor, Mass., with a view of erecting a dike for the protection of that harbor, made to comply with the provisions of the river and harbor act of June 3, 1896.

* Not reprinted. Printed in House Doc. No. 8, Fifty-fifth Congress, first session.

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The plan submitted by Colonel Mansfield for the protection of this harbor provides for riprap along the inside of the narrowest part of the neck of sand connecting the mainland and Long Point, this location being, in his opinion, the proper one at present for the protection of the harbor. The cost of the proposed work is estimated at $13,200.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF LIEUT. COL. S. M. MANSFIELD, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., March 1, 1897.

GENERAL: In compliance with instructions of September 5, 1896, I have the honor to submit the following report (accompanied with a tracing) of the survey of Provincetown Harbor, Massachusetts, with a view of erecting a dike for the protection of that harbor, as provided for in the river and harbor act of June 3, 1896:

The survey was made in October, 1896, and its range, because of the limited funds at my disposal, was confined to making a careful and detailed examination of such portions only as would clearly show the necessity for additional works for defense against impairment of the harbor, and the probable location of such works.

Provincetown Harbor is at the extremity of Cape Cod, 40 miles southeast of Boston Harbor.

The location, the accessibility of the harbor, and its well-protected anchorage entitle it to be ranked as one of the most important harbors of refuge upon the Atlantic Coast. From the north and west it is sheltered by the mainland, and through the south and east it is separated from the ocean by a narrow neck of sand of varying width, terminating at Long Point on the south side of the harbor entrance. It has an anchorage area of about 675 acres, with a depth of 18 feet or more at mean low water.

House Point Island Flats lie to the southwest of the harbor, between it and the narrow neck of sand, covering 800 acres and measuring about 5,500 feet across to the sea. At high water these flats are overflowed, and the only barrier then between the harbor and the ocean is this neck of sand, varying in width from 145 feet to 400 feet through a length of about 8,000 feet. Its narrowest portion is the location where fear of injury to the harbor is felt.

A close survey was made of 4,100 feet of the neck in this locality; 22 cross sections were leveled at intervals of 200 feet along the base line X Y from low water on the ocean side to low water of the harbor.

To define the present position of the edge of House Point Island Flats and determine their condition, 3,687 soundings were taken over 43 ranges, and of these soundings 378 were intersected with a transit from shore stations. The bench mark is the top of the foundation at the southeast corner of Centenary Church in Provincetown, and is 30.17 feet above mean low water. The soundings are recorded upon the chart in feet and tenths. The high-water line elsewhere upon the chart is taken from the United States Engineer survey of 1886.

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COMPARISON WITH FORMER SURVEYS.

A comparison of this survey with the elaborate one by Col. J. D. Graham in 1835 shows that the low-water line and the 6-foot contour of House Point Island Flats have moved northward, but the 12-foot contour and deeper contours are essentially the same in the two surveys, indicating that in the period of sixty-one years which has elapsed there has been no encroachment on the valuable deep-water anchorage of the harbor by any advancement of these flats.

The mean high-water lines on the ocean side of the neck opposite the flats are essentially identical in both surveys. The threatening danger is not to be looked for coming from the ocean side, but rather from the harbor side, where the comparison of surveys shows that the high-water line is receding and encroaching upon the narrow sandy barrier between the harbor and ocean. A reference to some intermediate surveys and the observations of recent years show that the movement is a continuous one.

Comparative cross sections show extensive wear above mean high water and a lowering of the height of this barrier as the result of storm winds and waves, and indications of a natural tendency to repair damage after the storms have passed. Most important of all, however, is the evidence which satisfies us that the forces acting upon the ocean side of this barrier have no disposition to break through it.

The prevailing drift of sand is along the shore toward Long Point, as is clearly indicated on the chart, showing a tendency toward adding to rather than cutting from the beach in the locality we are considering.

Comparisons with surveys later than 1835 show no essential change in the elevation of House Point Island Flats.

The survey was made "with a view of erecting a dike for the protection of the harbor."

The popular idea at Provincetown is that a dike should be built along the line from Stevens Point to House Point Island, and thence to Lobster Point, and such a dike has been officially suggested. Reference to it may be found in the Annual Report of the Chief of Engineers for 1886, page 574, where a plan and an estimate are supplied.

This location lends itself naturally and easily to the situation as viewed on the chart, and would appear to round up the harbor in fine shape. It is not improbable that a dike here would have the very opposite effect to that desired, and would be an injury rather than an improvement to the harbor. Should, however, this dike be built, the defense of Long Point can not safely be abandoned, for the destruction of this barrier would produce changes in the conditions and currents evidently too dangerous to be risked unless absolutely necessary.

Works for the defense of this barrier were undertaken about ten years ago, and have been successful, the harbor remaining in excellent condition, with no sign of deterioration.

It is plain that so long as the present conditions are preserved no injury to the harbor is to be feared, and House Point Island dike would therefore appear to be unnecessary.

These protective works should be strengthened immediately, and to this end I recommend a riprap along the inside of the neck where it is narrowest, near Wood End Light, similar to that so successfully employed on the outside of the point near Long Point Light, for here, in my opinion, is the true line of defense of the harbor.

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Estimate.

For 2,000 running feet of riprap dike, 6,000 tons rock, at $2 per ton	$12,000
Contingencies	1,200
Total	13,200

Respectfully submitted.

S. M. MANSFIELD,
Lieut. Col., Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

B 31.

MODIFICATION OF HARBOR LINES IN CHARLES RIVER, AT CAMBRIDGE, MASSACHUSETTS.

OFFICE OF THE MAYOR,
Cambridge, Mass., April 21, 1897.

DEAR SIR: The city of Cambridge, by its park department, is improving the banks of Charles River by the construction of a parkway along the northerly shore, necessitating filling and protecting the bank of the river to a considerable extent.

It is proposed to so treat a portion of the shore from Boylston street northwesterly to the land of the Cambridge Hospital. The pier and bulkhead line has been established here by a report and plan, approved by the Secretary of War, March 17, 1890. This line is made up by a series of straight lines, forming angles at their changes of direction.

In order to give a more pleasing and artistic effect to the lines of the parkway at this point, it is desired to lay out the banks and finish them with reference to the red line shown on the plan, departing slightly from the pier and bulkhead line of 1890. No solid filling is intended to be placed outside the line shown in red.

The consent of the harbor and land commissioners of this State has been obtained to the modification here asked for, and the further approval of the line by the War Department is now desired.

Yours, very respectfully,

ALVIN F. SORTWELL, *Mayor.*

Hon. RUSSELL A. ALGER,
Secretary of War.

[Second indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
April 42, 1897.

Respectfully referred to Lieut. Col. S. M. Mansfield, Corps of Engineers, for report.

To be returned.

By command of Brig. Gen. Wilson:

A. MACKENZIE,
Lieut. Col., Corps of Engineers.

[Third indorsement.]

U. S. ENGINEER OFFICE,
Boston, Mass., May 3, 1897.

Respectfully returned to the Chief of Engineers, U. S. A.

I can see no objection to the modification of the harbor line on Charles River as proposed herein, and recommend that the request be granted.

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It is believed there will be no material alteration in the volume of the tidal prism effected thereby.

S. M. MANSFIELD,
Lieut. Col., Corps of Engineers.

[Fourth indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
May 6, 1897.

Respectfully returned to the Secretary of War.

The mayor of Cambridge, Mass., requests that the harbor lines in Charles River, established by the Secretary of War March 17, 1890, be modified in part from Boylston street northwesterly to the land of the Cambridge Hospital, as shown in red on the accompanying blue print, for the purpose of facilitating the construction of a parking along the northerly shore of the river.

Lieutenant-Colonel Mansfield, to whom the application was referred, recommends in preceding indorsement that the request be granted, he being of opinion that the proposed change in the lines will result in no material alteration in the volume of the tidal prism affected.

Concurring in the views and recommendation of Colonel Mansfield, it is recommended that the proposed modification in the lines be approved, and that the Secretary place his approval upon the blue print, which has been prepared for his signature.

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

[NOTE.—The lines referred to in the above letter, and shown on the map accompanying, were approved by the Secretary of War under date of May 8, 1897, the approval being indicated on the map.]

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APPENDIX C.

IMPROVEMENT OF RIVERS AND HARBORS IN SOUTHEASTERN MASSACHUSETTS AND IN RHODE ISLAND.

REPORT OF MAJ. D. W. LOCKWOOD, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1897, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Harbor of refuge at Hyannis, Massachusetts.
2. Harbor of refuge at Nantucket, Massachusetts.
3. Marthas Vineyard, inner harbor at Edgartown, Massachusetts.
4. Harbor at Vineyard Haven, Massachusetts.
5. Woods Hole Channel, Massachusetts.
6. New Bedford Harbor, Massachusetts.
7. Canapitsit Channel, Massachusetts.
8. Taunton River, Massachusetts.
9. Sakonnet River, Rhode Island.
10. Pawtucket River, Rhode Island.
11. Providence River and Narragansett Bay, Rhode Island.
12. Green Jacket Shoal, Providence, Rhode Island.
13. Wickford Harbor, Rhode Island.
14. Newport Harbor, Rhode Island.
15. Harbor of refuge at Point Judith, Rhode Island.
16. Entrance to Point Judith Pond, Rhode Island.
17. Harbor of refuge at Block Island, Rhode Island.
18. Great Salt Pond, Block Island, Rhode Island.
19. Removing sunken vessels or craft obstructing or endangering navigation.

EXAMINATION.

20. Channel through Conanicut Island, Narragansett Bay, Rhode Island.

SURVEYS.

21. Channel in New Bedford Harbor, Massachusetts.
22. Mount Hope Bay and Fall River Harbor, Massachusetts.
23. Sakonnet Point, Rhode Island.
24. Easterly breakwater to shore, Point Judith Harbor of Refuge, Rhode Island.

UNITED STATES ENGINEER OFFICE,
Newport, R. I., July 15, 1897.

GENERAL: I have the honor to transmit herewith annual report on river and harbor works under my charge at close of fiscal year ending June 30, 1897.

First Lieut. Charles H. McKinstry, Corps of Engineers, has been on duty under the direction of this office during the year.

Very respectfully, your obedient servant,

D. W. LOCKWOOD,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

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C 1.

HARBOR OF REFUGE AT HYANNIS, MASSACHUSETTS.

The harbor of Hyannis lies on the south shore of the peninsula of CapeCod, about 15 miles to the westward of the heel of the cape, and is an important harbor of refuge. (For map see page 592, Annual Report of 1884.)

The mean rise and fall of the tide is about 3.75 feet.

Original condition.—Before improvement it was an open roadstead, exposed to southerly storms.

At the adoption of the present project the 15.5 feet depth anchorage area protected by the breakwater covered only about 47 acres.

Present project.—The present project, that of 1884, provides for the deepening to 15.5 feet at mean low water, by dredging, of about 36 additional acres of protected area, to be limited on the west by a line running due north from the western end of the breakwater, and on the north by a line running parallel to the breakwater and 1,500 feet from it, leaving a berm of 100 feet along the northern side of the breakwater, at a cost estimated in 1884 at $45,743.20. A plan of the works may be found at page 560, Annual Report of the Chief of Engineers for 1885, and page 804 of 1893, and further information at page 621 of 1885.

Amount expended and results to June 30, 1896.—In the years 1827–1838 a breakwater of riprap granite, 1,170 feet long, was constructed, covering an anchorage of about 175 acres, the entrance to which had a depth of about 15.5 feet. In the years 1852–1882 extensive repairs were made in increasing the width of its base and the size of the stone forming its sides and top. One hundred and twenty-three thousand three hundred and fifty dollars and sixty-two cents was spent on this work. The total amount expended on the present project up to June 30, 1896, was $34,403.07, by which 20 acres of the 36 had been deepened to 15.5 feet, and a contract for about $2,000 worth of dredging was made with the Hartford Dredging Company, of Hartford, Conn., at 17.3 cents per cubic yard, under date of April 13, 1895.

Operations during the past fiscal year.—The work of dredging under the above contract was commenced August 3 and completed August 29, 1896. Eleven thousand seven hundred and forty cubic yards of material were excavated, adding about 1.2 acres to the area dredged. Under authority of Department indorsement of August 25, 1896, the contractor continued the dredging a few days to use up a small available balance of funds, removing 3,041 cubic yards of material. Amount expended, $2,996.95.

A contract for dredging under the 1896 appropriation was entered into on September 14, 1896, with the Hartford Dredging Company, of Hartford, Conn., at 21 cents per cubic yard.

This work was in the local charge of Mr. Edward Parrish as assistant engineer, with Messrs. C. O. Abell and James D. Hamilton as inspectors.

Work required to complete the existing project.—The work still required to complete the existing project is the completion of the dredging to a depth of 15.5 feet over the remaining 14 acres of the proposed anchorage area.

Operations contemplated for the fiscal year ending June 30, 1898.—It is proposed to apply the balance on hand and the next appropriation toward the completion of the anchorage area inside the breakwater.

Hyannis Harbor is in the Barnstable collection district, and Barnstable is the nearest port of entry. The amount of revenue collected at Barnstable in the last calendar year was $130.56.

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The main value of the harbor is for a harbor of refuge. The nearest light-house is Hyannis Light; the nearest fortification is the fort at Clark's Point, New Bedford, Mass.

Money statement.

July 1, 1896, balance unexpended	$9,179.13
From sales	20.68
	9,199.81
June 30, 1897, amount expended during fiscal year	2,996.95
July 1, 1897, balance unexpended	6,202.86
July 1, 1897, amount covered by uncompleted contracts	4,800.00
July 1, 1897, balance available	1,402.86
Amount (estimated) required for completion of existing project	2,162.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	2,162.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

AMOUNTS APPROPRIATED.

Previous projects.

March 2, 1827	$10,650.00	July 11, 1870	$12,000.00
April 30, 1830	6,517.82	March 3, 1871	10,000.00
March 2, 1831	8,400.00	March 3, 1873	10,000.00
July 3, 1832	7,600.00	June 23, 1874	5,000.00
March 2, 1833	5,000.00	June 18, 1878	3,000.00
June 28, 1834	10,000.00	March 3, 1879	2,500.00
March 3, 1835	9,000.00	March 3, 1881	5,000.00
March 3, 1837	5,000.00		
July 7, 1838	8,764.00	Total	123,431.82
August 30, 1852	5,000.00		

Existing project.

August 5, 1886	$10,000.00
August 11, 1888	10,000.00
September 19, 1890	8,000.00
July 13, 1892	6,000.00
August 17, 1894	3,500.00
June 3, 1896	6,000.00
Total	43,500.00
Received from sale of material	20.68
Total	43,520.68

Abstract of proposals received and opened August 29, 1896, by Maj. D. W. Lockwood, Corps of Engineers, for dredging for improving harbor at Hyannis, Mass.

No.	Name and address of bidder.	Rate per cubic yard.
1	The Hartford Dredging Co., Hartford, Conn	$0.21
2	Thos. A. Scott, New London, Conn	.25

Contract awarded to The Hartford Dredging Company

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Contracts in force.

Contractor.	Date of approval.	To commence.	To complete.
The Hartford Dredging Co	Apr. 30, 1895	*a* June 1, 1895	Sept. 1, 1896
Do	Oct. 16, 1896	*b* May 1, 1897	Aug. 1, 1897

a Extended to March 15, 1896. *b* Extended to July 15, 1897.

COMMERCIAL STATISTICS.

The commerce arriving and leaving Hyannis Harbor, Massachusetts, by water during the calendar year ending December 31, 1896, is estimated as follows (based mainly upon reports received from Mr. Thomas C. Day, collector of customs, Barnstable, Mass., and Messrs. T. Crocker & Sons, Hyannis, Mass.):

Class of goods.	1891.	1892.	1893.	1894.	1895.	1896.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Tobacco				5	15	20
Rice				2	2	
Grains and forage	4,906	5,000	4,000	1,000	3,750	1,000
Vegetables and truck	30	30	300	80	1	300
Live stock and products			100	134	75	
Fish, oysters, etc	182	190	150	195	1,032	200
Lumber and products	682	1,800	200	2,400	2,850	2,500
Coal, minerals, etc	13,222	13,200	30,000	14,500	14,500	18,000
Fertilizers			50	50		
General merchandise	114	450	8,200	270		2,000
Sundries	200	200			300	200
Total	19,336	20,900	43,000	18,636	22,525	24,220

New transportation companies established during the year, none reported.

The vessels entering and leaving this waterway are as follows (each entrance and departure together being counted as one):

Character or class of service.	Number.	Average draft.	Average tonnage.
		Feet.	*Tons.*
Steam:			
Freight mainly	20	11	150
Passenger mainly	30	12	250
Fishing	30	8	50
Tugs	200	11	100
Pleasure boats	1,000	5	13
Sail:			
Freight	100	11	250
Fishing boats	700	2	5
Pleasure boats, large	400	10	100
Pleasure boats, small	800	2	5
Barges	20	7	50

C 2.

HARBOR OF REFUGE AT NANTUCKET, MASSACHUSETTS.

Nantucket Harbor is the only well-protected harbor on Nantucket Sound between the harbors of Marthas Vineyard (Vineyard Haven and Edgartown) and Provincetown, a distance of about 100 miles, except the small harbor of Hyannis, on the other (the north) side of Nantucket Sound. The navigation of this sound is intricate and dangerous by reason of numerous shoals. Nantucket Harbor has a considerable area with a depth of water in excess of 12 feet, and the object of the improvement is to make it a harbor of refuge for vessels plying between

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ports north and south of Cape Cod, estimated to be 50,000 annually. In the memorial to Congress on which the first appropriation for this harbor of refuge was based it was stated that more than 500 vessels had been wrecked in the vicinity of the island. (For map of harbor see page 423, Annual Report of 1880, and page 576 of Report of 1885.)

The mean rise and fall of the tide is about 3 feet.

Original conditions.—At the adoption of the present project no jetties existed, and the channel entrance was barred by a shoal of 1.5 miles width on which there was only 6 feet depth of water at low tide, the channel being very crooked and subject to changes in location.

Present project.—The present approved project, that of 1880, as modified in 1885, provides for the construction of two jetties as training walls, one on each side of the harbor entrance, planned so as to allow the tidal current to assist in scouring out and maintaining a good channel, and for the completion of the work by dredging where necessary, to obtain a depth of from 12 to 15 feet at low water in this channel, all at a total cost estimated in 1885 at $375,000.

A plan of the works may be found at page 578, Annual Report of the Chief of Engineers for 1885, and page 806 of 1893; and further information at page 436 of 1880, page 544 of 1881, page 595 of 1884, and pages 563, 575, 578 of 1885.

Amount expended and results to June 30, 1896.—The funds appropriated from 1829 to 1844, $45,734.75, were expended in ineffectual dredging of an entrance channel. The amount expended on the present project up to June 30, 1896, was $213,410.37, by which the west jetty had been built to 3,955 feet length of full height, and strengthened and leveled up at points where it had settled and been somewhat washed down; the east jetty had been built up to its full height for a length of 834 feet from the shore end, then the foundation laid for a length of 191 feet, then came a gap of 160 feet, then 1,300 feet raised to half-tide level, then 2,145 feet raised to 1.5 feet below low-tide level, and a portion of the core and facing laid for an additional distance of 210 feet, the total length from the shore end being 4,840 feet.

There is now a depth of 8 feet in the channel, which before improvement was limited to 6 feet.

Operations during the past fiscal year.—The amount expended during the past fiscal year was $3,881.41.

No work was in progress at the commencement of the fiscal year. A contract for jetty work under the 1896 appropriation was entered into on September 28, 1896, with Messrs. S. & E. S. Belden, of Hartford, Conn., at $1.93 per ton for placing stone at the outer end of the east jetty, and $2.47 per ton for building up to its full height that portion of the east jetty that had been built up to half-tide level. Under the provisions of this contract, the contractor, during the month of September, 1896, placed 1,230 tons of stone at the outer end of the east jetty, completing this part of the contract, and bringing that portion of the jetty up to the level of 1.5 feet below mean low water and building a mound of heavy stone to protect a lantern staff near the present end of the jetty.

For dimensions of jetty and method of construction see Annual Report of the Chief of Engineers for 1896, part 1, page 627.

In December, 1896, during an unusually severe storm, a breach was made between the ocean and the head of the harbor, at what is called the "Haulover." Reports thereon were submitted in January and February, and a more detailed report, after a careful examination of the existing conditions, was submitted in May, 1897.

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The breach does not appear to have caused any perceptible change in the depth of water at the harbor entrance, but to avoid narrowing this entrance too much while the breachway was operative it was deemed advisable to expend the balance of present appropriation in extending the west jetty, and a supplemental contract was entered into with the present contractors providing for this extension; the price of stone per ton being the same as provided for similar work on east jetty, to wit, $1.93.

Active operations were commenced by the contractors on June 12, 1897, and 1,650 tons of stone were deposited in the west jetty, extending the same by about 300 feet of partial section.

A light was maintained near the outer end of each jetty during the year.

This work was in the local charge of Mr. Edward Parrish as assistant engineer.

Work required to complete the existing project.—The work required to complete the existing project is the raising of the incomplete parts of the east jetty, the further extension of both jetties, and the excavation by dredging of so much of the channel as may not be excavated by tidal scour.

Operations contemplated for the fiscal year ending June 30, 1898.—It is proposed to extend the west jetty.

Nantucket is in the Nantucket collection district and is a port of entry. No revenue was collected during the last calendar year. The value of the harbor is mainly as a harbor of refuge. The nearest light-houses are Nantucket Cliff and Brant Point lights. The nearest fortification is the fort at Clarks Point, New Bedford, Mass.

Money statement.

July 1, 1896, balance unexpended		$26,589.63
June 30, 1897, amount expended during fiscal year		3,881.41
July 1, 1897, balance unexpended		22,708.22
July 1, 1897, outstanding liabilities	$3,585.33	
July 1, 1897, amount covered by uncompleted contracts	16,441.60	
		20,026.93
July 1, 1897, balance available		2,681.29
Amount (estimated) required for completion of existing project		135,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

AMOUNTS APPROPRIATED.

Previous projects.

May 23, 1828, survey	$300.00	June 14, 1844	$1,169.75
March 2, 1829	30,000.00		
March 2, 1831	8,265.00	Total	45,734.75
July 3, 1832	6,000.00		

Existing project.

July 14, 1880	$50,000.00	September 19, 1890	$25,000.00
March 3, 1881	25,000.00	July 13, 1892	25,000.00
August 2, 1882	25,000.00	August 17, 1894	25,000.00
July 5, 1884	10,000.00	June 3, 1896	20,000.00
August 5, 1886	15,000.00		
August 11, 1888	20,000.00	Total	240,000.00

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Abstract of proposal received and opened September 4, 1896, at office of Maj. D. W. Lockwood, Corps of Engineers, for breakwater construction for improving harbor at Nantucket, Mass.

No.	Name and address of bidder.	Rate per ton of 2,000 pounds.	
		Outer part.	Middle part.
1	S. & E. S. Belden, Hartford, Conn	$1.93	$2.47

Contract awarded to S. & E. S. Belden.

Contract in force.

Contractor.	Date of approval.	To commence.		To complete.
		At outer end of east jetty.	Balance of work.	
S. & E. S. Belden	Oct. 12, 1896	Oct. 15, 1896	May 15, 1897	Dec. 15, 1897

COMMERCIAL STATISTICS.

The commerce arriving and leaving Nantucket Harbor, Massachusetts, by water during the calendar year ending December 31, 1896, is estimated as follows (based mainly upon reports received from Mr. Joseph W. Clapp, collector of customs):

Class of goods.	1891.	1892.	1893.	1894.	1895.	1896.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Tobacco	75	50	70	.....	40	30
Rice	6	6	60	40	2	3
Grains and forage	612	610	600	650	371	390
Vegetables and truck	.....	.....	600	600	415	340
Live stock and products	30	28	15	20	5	6
Fish, oysters, etc	73	70	400	450	500	400
Naval stores	.....	.....	10	10	8	3
Lumber and products	1,016	1,500	1,500	1,500	1,000	1,200
Coal, minerals, and products	6,301	7,000	7,500	8,000	7,000	8,000
Fertilizers	10	1,000	600	400	480	16
Machinery	77	150	100	150	30	2,000
General merchandise	225	1,500	1,500	1,550	1,560	1,600
Sundries	1,200	1,800	2,000	160	213	500
Total	9,625	13,709	14,955	13,530	11,624	14,488

New transportation companies established during the year, none.

The vessels entering and leaving this waterway are as follows (each entrance and departure together being counted as one):

Character or class of service.	Number.	Average draft.	Average tonnage.
		Feet.	*Tons.*
Steam:			
Freight and passenger	460	7	600
Freight, mainly	5	7	100
Passenger, mainly	3	7	200
Fishing	4	4	5
Tugs	2	5	6
Pleasure boats	20	6	5
Sail:			
Freight	4	7	8
Fishing boats	5	4	5
Pleasure boats, large	25	5	6
Pleasure boats, small	50	4	3

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C 3.

IMPROVEMENT OF MARTHAS VINEYARD INNER HARBOR, AT EDGARTOWN, MASSACHUSETTS.

The inner harbor at Edgartown lies in the northern part of the waterway or strait that separates Chapaquiddick Island from the east end of Marthas Vineyard. It extends southward about 1.5 miles from Chapaquiddick Point, opposite Edgartown, and averages about one-fifth of a mile in width.

This harbor is so completely landlocked as to form a safe harbor of refuge for small vessels, but the contracted width of the entrance and the resulting velocity of the tidal currents make it difficult to reach or leave. (For map of this harbor see House Ex. Doc. No. 59, Fifty-first Congress, first session.)

Original condition.—At the adoption of the present project the middle-ground shoal carried only about 6 feet depth of water, and was a very troublesome obstruction.

Plan of improvement.—The present approved project, that of 1889, provides for the removal to 10 feet depth at low water of a "middle-ground" shoal in the central part of the inner harbor; all at a total cost estimated in 1893 at $7,000.

A description of the works may be found at page 588, Annual Report of the Chief of Engineers for 1890, and a plan of the same in House Ex. Doc. No. 59, Fifty-first Congress, first session, and page 810, Annual Report of 1893; and other special information at page 809, Annual Report of 1893.

Amount expended and results to June 30, 1896.—The total amount expended on the present project up to June 30, 1896, was $4,863.81, by which about three-fourths of the shoal had been dredged to full depth, and a contract for about $1,200 worth of dredging was made with the Hartford Dredging Company, of Hartford, Conn., at 27.5 cents per cubic yard, under date of April 13, 1895.

Operations during the past fiscal year.—The amount expended during the past fiscal year was $2,136.19.

The work of dredging was commenced by the contractor in July, 1896, and completed the same month. Six thousand four hundred and eighty-five cubic yards of material was removed, completing all contract work, and removing all of the middle-ground but a small portion (about one-tenth of the area) on its eastern side.

This work of improvement was in the local charge of Mr. E. Parrish, as assistant engineer, with Mr. C. O. Abell and Mr. James D. Hamilton as inspectors.

Work required to complete the existing project.—The work required to complete the existing project is the excavation of the remaining portion of the middle-ground to a depth of 10 feet at mean low water.

Operations contemplated for the fiscal year ending June 30, 1898.—All funds being exhausted, no work is contemplated for the coming year.

Edgartown is in the Edgartown collection district and is a port of entry. The amount of revenue collected there during the last calendar year was $438.46. The nearest light-house is the Edgartown Light. The nearest fortification is the fort at Clarks Point, New Bedford, Mass.

Money statement.

July 1, 1896, balance unexpended	$2,136.19
June 30, 1897, amount expended during fiscal year	2,136.19

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AMOUNTS APPROPRIATED.

Existing project.

September 19, 1890	$2,000
July 13, 1892	2,500
August 17, 1894	2,500
Total	7,000

Contract in force.

Contractor.	Date of approval.	To commence.	To complete.
The Hartford Dredging Co	Apr. 30, 1895	June 1, 1895 *a*	Sept. 1, 1896

a Extended to March 15, 1896.

COMMERCIAL STATISTICS.

The commerce arriving and leaving Edgartown, Marthas Vineyard, Mass., by water during the calendar year ending December 31, 1896, is estimated as follows (based mainly upon reports received from Mr. Abraham Osborn, collector of customs, Edgartown, Mass.):

Class of goods.	1891.	1892.	1893.	1894.	1895.	1896.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Cotton and products	.....	2,500	30	600	2,750	2,800
Tobacco	30	30	600	75.5	55	60
Rice	2	3	1	.5	5	6
Grains and forage	2,599	900	3,000	3,750	1,300	1,500
Vegetables and truck	50	100	.....	55	225	250
Live stock and products	72	125	150	120	150	175
Fish, oysters, etc	847	1,200	2,000	1,450	2,000	2,200
Naval stores	.....	.....	.....	10	.....	.....
Lumber and products	6,600	8,000	.....	500	8,000	8,000
Coal, minerals, and products	4,075	2,500	4,000	4,700	3,000	3,200
Fertilizers	50	60	75	70	75	60
Machinery	515	500	600	50	40	50
General merchandise	4,125	9,000	7,000	5,650	11,000	12,000
Sundries	2,112	9,500	800	2,300	12,000	12,500
Total	21,077	34,400	18,256	19,331	40,600	42,801

New transportation companies established during the year, none.

The vessels entering and leaving this waterway are as follows (each entrance and departure together being counted as one):

Character and class of service.	Number.	Average draft.	Average tonnage.
		Feet.	*Tons.*
Steam:			
Freight and passenger	525	9	325
Passenger mainly	60	10.5	80
Fishing	80	9	90
Tugs	100	11	140
Pleasure boats	200	8	85
Sail:			
Freight	500	8	130
Fishing boats	13,500	3	3.5
Pleasure boats, large	500	4	20
Pleasure boats, small	3,500	2	3
Barges	50	14	900

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C 4.

IMPROVEMENT OF VINEYARD HAVEN HARBOR, MASSACHUSETTS.

Vineyard Haven is a deep indentation in the northern shore of the island of Marthas Vineyard, on the southern side of Vineyard Sound. It is triangular in form and faces the northeast. The width of the mouth of the harbor, or the distance between the points of land on the east and west sides of the entrance, known as East Chop and West Chop, is about 1.25 miles, and from a line connecting the chops to the narrow southerly end of the harbor, at which is situated the town of Vineyard Haven, the distance is about 1.75 miles. The entire area of the harbor between the shore lines is about 949 acres, of which some 657 acres have a depth of not less than 15 feet. The mean rise and fall of the tide is 1.7 feet.

Original condition.—At the mouth of the harbor the wearing away of the chops by the action of the waves in storms had been noted for many years. The former site of a light-house on West Chop had entirely disappeared. The débris was carried by the current into the harbor, where it formed shoals, which were gradually impairing the anchorage capacity, especially in the upper part of the harbor. (For map of harbor see p. 580 of Annual Report of 1887.)

Plan of improvement.—The present approved project, that of 1887 as modified in 1889, provides for the protection of the chops (or headlands) from erosion and the intervening harbor from being filled by the eroded material, the whole to be done by means of stone sea walls and jetties, to be built along the beach in front of the bluffs at both headlands, all at a total cost estimated in 1889 at $60,000.

A description of the work may be found at page 594, Annual Report of the Chief of Engineers for 1882, page 577 of 1887, and page 612 of 1889, and a map of the same at page 812 of 1893.

Amount expended and results to June 30, 1896.—The amount expended to June 30, 1896, was $42,762.18, by which there had been built a sea wall 960 feet long, a jetty 50 feet long, and 5 small spurs extending back from the sea wall to the foot of the bluff on the East Chop, and a sea wall 880 feet long and 3 jetties, 150, 135, and 280 feet long, a wharf, and a short stone breakwater 60 feet in length near the end of the wharf on the West Chop.

Operations during the past fiscal year.—The amount expended during the past fiscal year was $71.12.

A contract for about $12,000 worth of work, in constructing jetties and riprap walls, was entered into with Mr. William S. White, of Rockland, Me., under date of April 10, 1897, at the rate of $1.95 per ton of stone in position on the East and West chops.

Under the provisions of the above contract, the contractor commenced work on June 21, 1897, and placed 388 tons of stone, resulting in the building of 270 feet of the riprap wall to be constructed along the low water line in front of the bluff on the east side of the West Chop.

For dimensions of walls and details of construction, see Annual Report of Chief of Engineers for 1896, part 1, page 632.

This work was in the local charge of Mr. Edward Parrish as assistant engineer, with Mr. Arthur J. Ober as inspector.

Work required to complete the existing project.—The work required to complete the existing project is the completion of these systems of jetties and sea wall, for land protection at both chops.

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Operations contemplated for the fiscal year ending June 30, 1898.—It is proposed to complete the project.

Vineyard Haven is in the Edgartown collection district. Edgartown is the nearest port of entry. The amount of revenue collected at Edgartown in the last calendar year was $438.46. The nearest light-houses are those on East and West chops. The nearest fortification is the fort at Clarks Point, New Bedford, Mass.

Money statement.

July 1, 1896, balance unexpended		$14,237.82
June 30, 1897, amount expended during fiscal year		71.12
July 1, 1897, balance unexpended		14,166.70
July 1, 1897, outstanding liabilities	$872.15	
July 1, 1897, amount covered by uncompleted contracts	11,243.40	
		12,115.55
July 1, 1897, balance available		2,051.15
Amount (estimated) required for completion of existing project		3,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		3,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

AMOUNTS APPROPRIATED.

Existing project.

August 11, 1888	$25,000
September 19, 1890	10,000
July 13, 1892	7,500
August 17, 1894	7,500
June 3, 1896	7,000
Total	57,000

Abstract of proposals received and opened March 25, 1897, by Maj. D. W. Lockwood, Corps of Engineers, for constructing jetties and riprap walls for improving harbor at Vineyard Haven, Mass.

No.	Name and address of bidder.	Rate per ton of 2,000 pounds.
1	S. & E. S. Belden, Hartford, Conn	$4.33
2	Wm. S. White, Rockland, Me	1.95
3	Chas. W. Johnston, Philadelphia, Pa.	3.45

Contract awarded to Wm. S. White.

Contract in force.

Contractor.	Date of approval.	To commence.	To complete.
Wm. S. White	Apr. 22, 1897	May 1, 1897	Nov. 1, 1897

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COMMERCIAL STATISTICS.

The commerce arriving and leaving Vineyard Haven Harbor, Massachusetts, by water during the calendar year ending December 31, 1896, is estimated as follows (based mainly upon reports received from Mr. Max. Wagner, Weather Bureau Service, Vineyard Haven, Mass.):

Class of goods.	1891.	1892.	1893.	1894.	1895.	1896.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Cotton and products	.....	20	20	40	35	60
Tobacco	12	15	15	15	16	5
Rice	42	45	45	45	50	50
Grains and forage	2,165	2,500	2,500	800	1,100	2,000
Vegetables and truck	12	15	15	15	30	30
Live stock and products	179	200	200	200	150	200
Fish, oysters, etc	500	500	500	500	700	1,500
Naval stores	.....	.....	.....	60	10	20
Lumber and products	.....	2,500	2,500	350	900	3,000
Coal, minerals, and products	6,000	8,000	8,000	52,000	47,000	48,000
Fertilizers	50	50	50	50	40	100
Machinery	100	100	100	.....	50	50
General merchandise	4,140	5,000	5,000	5,000	8,500	6,000
Sundries	1,000	1,500	1,500	.....	.....	1,500
Total	14,200	20,445	20,445	59,075	58,581	62,515

New transportation companies established during the year, none.

The vessels entering and leaving this waterway are as follows (each entrance and departure together being counted as one):

Character or class of service.	Number.	Average draft.	Average tonnage.
Steam:		*Feet.*	*Tons.*
Freight and passenger	800	6	600
Freight mainly	400	16	1,000
Passenger mainly	50	6	600
Fishing	75	9	160
Tugs	400	12	110
Pleasure boats	600	12	200
Sail:			
Freight	4,000	12	600
Fishing boats	300	9	150
Pleasure boats, large	400	12	125
Pleasure boats, small	300	6	15
Barges	100	17	1,200

C 5.

IMPROVEMENT OF WOODS HOLE CHANNEL, MASSACHUSETTS.

This harbor is on the north side of Vineyard Sound, and is divided into Great Harbor and Little Harbor. The name of Woods Hole is also applied to the adjoining strait or channel which connects the waters of Buzzards Bay with Vineyard Sound and separates the chain of islands known as the Elizabeth Islands from the southwestern extremity of the peninsula of Cape Cod.

Original condition.—Before improvement the entrance to Little Harbor was obstructed by a bar with but 7.5 feet of water on it at mean low water. Great Harbor has ample depth. The site of the wharves and basins of the United States Fish Commission and Revenue Marine was a submerged point of land extending from the shore of the harbor. In the strait the channels were crooked and obstructed by numerous bowlders, and the velocity of the currents at certain stages of the tide was from 4 to 5 miles per hour.

Plans of improvement.—The project of 1879 provided for making a

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channel through the bar at the entrance to Little Harbor and widening and deepening the channel in the strait. The project of 1883, extended in 1884 and 1886, provided for the construction of a retaining wall on the shore, a hollow pier and wharves for the use of the United States Fish Commission, and to serve also as a coaling station for vessels of the Revenue Marine and other branches of the public service, and as a harbor of refuge, all of which was completed in 1888. In the project of 1895, which is the present approved project, it is proposed to give the channel through the strait and its southeastern branch a width of 300 feet and a low-water depth of 13 feet, at an estimated cost of $396,000.

Amount expended and results up to June 30, 1896.—The amount expended up to June 30, 1896, was $113,599.92. The first appropriation, that of 1852, had been expended in building a breakwater, which proved beneficial by arresting an influx of sand into Great Harbor. With the appropriation of 1879 the depth of water at entrance to Little Harbor had been increased from 7.5 to 10 feet, and a direct channel made 120 feet wide and 9 feet deep through the strait, benefiting greatly the commerce of Buzzards Bay. The wharves and piers had been completed in 1888, and a breach made in the east pier wall by storms and the wharves had been repaired in 1895. A survey of the strait and Little Harbor had been made, and report with project and estimate for further improvement was submitted August 17, 1895. (See p. 750 and p. 72, Annual Report Chief of Engineers, 1895.)

Operations during the past fiscal year.—The amount expended during the past fiscal year was $21.99. A contract for about $18,000 worth of dredging and removing bowlders was entered into with Mr. Charles W. Johnston, of Philadelphia, Pa., under date of April 12, 1897, at $7.75 per cubic yard.

This work was in the local charge of Mr. Edward Parrish, as assistant engineer.

Work required to complete the existing project.—The work required to complete the existing project is the widening and deepening the channel through the strait.

Operations contemplated for the fiscal year ending June 30, 1898.—It is proposed to expend the available funds in widening and deepening the channel through the strait.

Woods Hole is in the Barnstable collection district. New Bedford is the nearest port of entry. The amount of revenue collected in the last calendar year was, at Barnstable, $130.56, and at New Bedford, $100,735.85. The nearest light-house is Nobska Light. The nearest fortification is the fort at Clarks Point, New Bedford, Mass.

Money statement.

July 1, 1896, balance unexpended		$20,000.00
June 30, 1897, amount expended during fiscal year		21.99
July 1, 1897, balance unexpended		19,978.01
July 1, 1897, outstanding liabilities	$0.50	
July 1, 1897, amount covered by uncompleted contracts	18,000.00	
		18,000.50
July 1, 1897, balance available		1,977.51

Amount (estimated) required for completion of existing project..... 376,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899 150,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

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AMOUNTS APPROPRIATED.

August 10, 1852	$2,500.00
March 3, 1879	15,000.00
August 2, 1882	52,000.00
July 5, 1884	25,000.00
August 5, 1886	14,500.00
March 2, 1895	5,000.00
June 3, 1896	20,000.00
Total	134,000.00
December 5, 1895, unexpended balance deposited to the credit of the United States Treasurer	400.08
Total	133,599.92

Abstract of proposals received and opened March 25, 1897, by Maj. D. W. Lockwood, Corps of Engineers, for dredging and removing bowlders for improving Woods Hole Channel, Massachusetts.

No.	Name and address of bidder.	Rate per cubic yard.	
		Dredging.	Bowlders.
1	Charles W. Johnston, Philadelphia, Pa	$7.75	$7.75
2	R. G. & J. S. Packard, New York, N. Y	2.50	35.00

Contract awarded to Charles W. Johnston.

Contract in force.

Contractor.	Date of approval.	To commence.	To complete.
Charles W. Johnston	May 8, 1897	*a* May 1, 1897	Dec. 31, 1897

a Extended to September, 1897.

COMMERCIAL STATISTICS.

The commerce arriving and leaving Woods Hole, Mass., by water during the calendar year ending December 31, 1896, is estimated as follows (based mainly upon reports received from Mr. Walter D. Luscombe, of Woods Hole, Mass.):

Class of goods.	1894.	1895.	1896.
	Tons.	*Tons.*	*Tons.*
Grains and forage	2,275	2,265	3,000
Vegetables and truck	4	8	9
Live stock and products	123	150	150
Fish, oysters, etc	158	225	200
Naval stores	5	5	15
Lumber and products	2,170	4,000	3,900
Coal, minerals, and products	2,025	4,000	5,000
Fertilizers	100	50	75
General merchandise	1,115	1,082	1,200
Total	7,975	11,785	13,549

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New transportation companies established during the year, none.

The vessels entering and leaving this waterway are as follows (each entrance and departure together being counted as one):

Character or class of service.	Number.	Average draft.	Average tonnage.
		Feet.	*Tons.*
Steam:			
Freight and passenger	4	10	900
Freight mainly	1	7	20
Fishing	2	8	30
Tugs	20	10	350
Pleasure boats	25	10	100
Sail:			
Freight	50	8	150
Fishing boats	100	8	50
Pleasure boats, large	35	4	15
Pleasure boats, small	20	3	5

C 6.

IMPROVEMENT OF NEW BEDFORD HARBOR, MASSACHUSETTS.

New Bedford Harbor is an estuary of Buzzards Bay and is the port of the cities of New Bedford and Fairhaven, Mass. New Bedford is an important port of entry. It is largely interested in manufactures, those of cotton predominating, and has an extensive commerce in addition to its whale fisheries. The population of New Bedford and Fairhaven in 1890 was about 45,000.

The mean rise and fall of the tide is about 4.2 feet.

Original condition.—Before improvement the channel had a ruling depth of about 12.5 feet at mean low water.

At the adoption of the present project the channel was winding and about 15 feet deep.

Plan of improvement.—The project of 1887, which provided for a channel 200 feet wide and 18 feet deep at mean low water from Buzzards Bay to New Bedford, at an estimated cost of $35,000, has been practically completed. The present approved project, that of 1895, provides for dredging an anchorage area one-half mile long, 600 feet wide, and 18 feet deep at mean low water on the north side of the channel leading from New Bedford to Fairhaven.

A description of the works may be found at page 514, Annual Report of the Chief of Engineers for 1888, and a plan of the same in House Ex. Doc. No. 86, Fiftieth Congress, first session, and at page 816, Annual Report for 1893; also at page 672, Annual Report for 1896, and in House Ex. Doc. No. 59, Fifty-fourth Congress, first session.

Amount expended and results up to June 30, 1896.—The total amount expended to June 30, 1896, was $70,387.99, of which $17,691.37 had been expended in 1836–1839 in removing a wreck and dredging the sand bar which had been formed by it; $20,000 had been expended in 1875 to 1877 in completing a channel 300 feet wide and 15 feet deep from the deep water above Palmers Island to the wharves of New Bedford, and $32,696.62 since 1888 in deepening the channel to 18 feet at mean low water for a width of 200 feet from the wharves in New Bedford to the deep water of Buzzards Bay. The latter channel had been nearly completed.

A contract for about $5,000 worth of dredging had been entered into with the Hartford Dredging Company of Hartford, Conn., under date of April 13, 1895, at 17 cents per cubic yard.

A survey of the upper part of the harbor, for use in estimating the

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cost of an anchorage area, had been made, and report thereon submitted November 23, 1895, and published as House Ex. Doc. No. 59, Fifty-fourth Congress, first session.

Operations during the past fiscal year.—The amount expended during the past fiscal year was $10,255.09.

The contract for dredging in the 18-foot channel, in progress at the beginning of the fiscal year, was completed in July, 1896, by the removal of 1,246 cubic yards of material, completing all of the lower reach excepting a small area at Butlers Flats, and all contract work under the 1894 appropriations.

A contract for about $8,500 worth of dredging in the proposed anchorage area was entered into with the Hartford Dredging Company, of Hartford, Conn., under date of September 26, 1896, at 12.7 cents per cubic yard. Under the provisions of this contract work was commenced with two dredges in March, 1897, and completed on June 17, 1897. Sixty-eight thousand eight hundred and eighty-seven cubic yards of material were dredged, adding 11 acres to the 18-foot anchorage area in the harbor, and completing all contract work under the 1896 appropriations.

This work was in the local charge of Mr. E. Parrish as assistant engineer, with C. O. Abell, T. W. Kennan, John A. Dill, and Philip S. Spooner as inspectors.

New Bedford Harbor is in the New Bedford collection district, and is a port of entry. The amount of revenue collected in the last calendar year was $100,735.85. The nearest light-houses are Clarks Point Light and the lights in New Bedford Harbor. The nearest fortification is fort at Clarks Point, Massachusetts.

Money statement.

July 1, 1896, balance unexpended	$12,303.38
From sales	9.00
	12,312.38
June 30, 1897, amount expended during fiscal year	10,255.09
July 1, 1897, balance unexpended	2,057.29
July 1, 1897, outstanding liabilities	1,942.26
July 1, 1897, balance available	115.03
Amount (estimated) required for completion of existing project	47,689.33
Amount that can be profitably expended in fiscal year ending June 30, 1899	47,689.33
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

AMOUNTS APPROPRIATED.

July 4, 1836	$10,000.00
July 7, 1838	7,691.37
March 3, 1875	10,000.00
August 14, 1876	10,000.00
August 11, 1888	10,000.00
September 19, 1890	10,000.00
July 13, 1892	7,500.00
August 17, 1894	7,500.00
June 3, 1896	10,000.00
Total	82,691.37
Received from sale of material	9.00
Total	82,700.37

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Abstract of proposals received and opened September 4, 1896, at office of Maj. D. W. Lockwood, Corps of Engineers, for dredging for improving harbor at New Bedford, Mass.

No.	Name and address of bidder.	Rate per cubic yard.
		Cents.
1	Columbia Dredging Co., Fall River, Mass	15.9
2	The Hartford Dredging Co., Hartford, Conn	12.7

Contract awarded to the Hartford Dredging Company.

Contracts in force.

Contractors.	Date of approval.	To commence.	To complete.
The Hartford Dredging Co	Apr. 30, 1895	*a* June 1, 1895	Sept. 1, 1896
Do	Oct. 16, 1896	May 1, 1897	Sept. 1, 1897

a Extended to March 15, 1896.

COMMERCIAL STATISTICS.

The commerce arriving and leaving New Bedford, Mass., by water during the calendar years 1891–1896 is estimated as follows (based mainly upon reports received from Mr. Z. W. Pease, collector of customs, New Bedford, Mass.):

Class of goods.	1891.	1892.	1893.	1894.	1895.	1896.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Cotton and products	15	14,200	13,500	10,500	9,036	22,400
Tobacco	2	2	5	14	28	50
Grains and forage	4,690	23,000	21,000	24,400	30,470	15,000
Vegetables and truck	.....	930	650	2,630	2,920	7,100
Live stock and products	39	70	200	100	160	500
Fish, oysters, etc	.....	92,000	5,500	2,378	1,783	3,250
Naval stores	4	2,000	.....	1,275	1,275	.....
Lumber and products	824	30,400	2,500	21,400	22,500	33,500
Coal, minerals, and products	467,035	400,300	450,000	459,000	517,375	650,000
Fertilizers	.....	.....	.....	.....	60	150
General merchandise	15,252	112,000	103,000	59,515	62,160	100,000
Sundries	62	52,000	33,000	.....	11,656	10,000
Total	488,523	727,000	629,355	581,212	659,423	841,950

New transportation companies established during the year, none reported.

The vessels entering and leaving this waterway are as follows (each entrance and departure together being counted as one):

Character or class of service.	Number.	Average draft.	Average tonnage.
		Feet.	*Tons.*
Steam:			
Freight and passenger	700	8	560
Freight mainly	500	17	1,000
Passenger mainly	500	8	60
Tugs	775	8	50
Pleasure boats	250	8	50
Sail:			
Freight	1,350	13	1,100
Fishing boats	550	5	10
Pleasure boats, large	400	9	40
Pleasure boats, small	1,000	5	10
Barges	420	13	1,000

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C 7.

IMPROVEMENT OF CANAPITSIT CHANNEL, MASSACHUSETTS.

This waterway lies about 20 miles south of New Bedford, running between the islands of Cuttyhunk and Nashawena, Massachusetts, and connecting the waters of Vineyard Sound and Buzzards Bay.

The object of the improvement is to make this channel safe for the use of light-draft sailboats, and also especially of the surf boats belonging to the life-saving station of this dangerous locality.

Original condition.—Before improvement the sand shoals and numerous bowlders made this passage specially dangerous to the life-saving station boats and other shallow-draft row and sail boats.

Plan of improvement.—The present approved project, that of 1891, provides for the widening and deepening of the present channel from Vineyard Sound to Buzzards Bay, so as to secure a depth of 6 feet at low water, with a least width of 150 feet over its entire length, all at a total cost estimated in 1893 of $9,800.

A description of the work may be found at page 645, Annual Report of the Chief of Engineers for 1892, and a plan of the same in House Ex. Doc. No. 59, Fifty-second Congress, first session, and at page 820 of Annual Report for 1893; and further special information on page 820, Annual Report for 1893.

Amount expended and results to June 30, 1896.—The amount expended up to June 30, 1896, was $5,236.04, by which a channel of 66 feet width and about 5 feet depth at low water was cut entirely through from Buzzards Bay to Vineyard Sound, and a contract for about $3,500 worth of work was entered into with the Hartford Dredging Company, of Hartford, Conn., under date of April 13, 1895, at 36 cents per cubic yard. The work heretofore has been done by hired labor and the use of the Government plant, the method adopted being to loosen the very compact material of the bottom with dynamite, and then remove it with a clam-shell dredge at the time belonging to the Government.

Operations during the past fiscal year.—No funds were expended during the past fiscal year.

As the exposed position of this work requires that it should be done during the summer season, the contractor did not move his plant to the place of work until the 29th of June, and work was commenced the following day.

Work required to complete the existing project.—The work yet to be done is to deepen the channel throughout its entire length, the 66-feet-width channel by about 1 foot, and the remaining channel, of 83 feet to 283 feet width, by about 2 feet.

Operations contemplated for the fiscal year ending June 30, 1898.—It is proposed to complete the project.

Canapitsit Channel is in the New Bedford collection district. New Bedford is the nearest port of entry. The amount of revenue collected at New Bedford in the last calendar year was $100,735.85. The nearest light-houses are the Cuttyhunk and Gay Head light-houses. The nearest fortification is fort at Clarks Point, Massachusetts.

Money statement.

July 1, 1896, balance unexpended		$4,563.96
July 1, 1897, balance unexpended		4,563.96
July 1, 1897, outstanding liabilities	$107.38	
July 1, 1897, amount covered by uncompleted contracts	3,500.00	
		3,607.38
July 1, 1897, balance available		956.58

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AMOUNTS APPROPRIATED.

July 13, 1892	$4,800
August 17, 1894	5,000
Total	9,800

Contract in force.

Contractor.	Date of approval.	To commence.	To complete.
The Hartford Dredging Co	Apr. 30, 1895	*a* June 1, 1895	*b* Sept. 1, 1896

a Extended to March 15, 1897 *b* Extended to July 1, 1897.

COMMERCIAL STATISTICS.

The commerce arriving and leaving Cuttyhunk, Mass., by water during the calendar years ending December 31, 1892–1896, is estimated as follows (based mainly upon reports received from Mr. D. P. Bosworth, Cuttyhunk, Mass.):

Class of goods.	1892.	1893.	1894.	1895.	1896.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Cotton and products	.....	1	.....	.....	2
Tobacco	1	2	1	2	3
Grains and forage	16	25	47	57	100
Vegetables and truck	3	4	10	14	18
Live stock and products	4	10	136	140	140
Fish, oysters, etc	180	250	1,000	1,100	2,000
Naval stores	2	2	2.5	3	3
Lumber and products	40	70	102	150	100
Coal, minerals, and products	350	50	50	100	150
Fertilizers	.....	2	5	5	5
Machinery	.....	2	.....	.....	.....
General merchandise	20	250	193	200	250
Sundries	70	40	87	100	150
Total	700	708	1,633.5	1,871	2,921

New transportation companies established during the year, none reported.

The vessels entering and leaving this waterway are as follows (each entrance and departure together being counted as one):

Character or class of service.	Number.	Average draft.	Average tonnage.
		Feet.	*Tons.*
Steam:			
Freight, mainly	195	6	60
Tugs	20	9	80
Pleasure boats	100	5	30
Sail:			
Freight	75	4	11
Fishing boats	1,700	4	5
Pleasure boats, large	150	8	80
Pleasure boats, small	300	3	4

C 8.

IMPROVEMENT OF TAUNTON RIVER, MASSACHUSETTS.

This river rises in Norfolk County, Mass., and empties in Mount Hope Bay, a part of Narragansett Bay. It is about 44 miles in length.

The object of the improvement is to deepen and widen the channel

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so that vessels of 11 feet draft can at high water go up to the city of Taunton, which for its extensive manufactures requires large quantities of coal, iron, clay, molding sand, and other heavy articles. The rise and fall of the tide before improvement was 5.25 feet at Dighton and 3.4 feet at Taunton.

Original condition.—In its original condition the channel was narrow and obstructed by bowlders, and from Berkley Bridge to Taunton its depth was not, in places, more than 5 feet at mean high water. A vessel of 30 tons burden was as large as could go up to Taunton.

At the adoption of the present project the channel was limited to 9 feet at high water, and was too narrow and too much obstructed by bowlders for easy navigation by the craft making use of it.

Plan of improvement.—The present approved project, that of 1880, provides for the widening and deepening of the river so as to secure a channel of at least 12 feet depth at high water, with 100 feet width from its mouth up to Berkley Bridge (above Dighton); thence 12 feet depth with 80 feet width (100 feet width at bends) up to Briggs Shoal; thence 11 feet depth with the same width up to the shipyard; thence 11 feet depth with 60 feet width up to the Weir Bridge, Taunton; all at a total cost estimated in 1893 at $125,000.

A plan of the works may be found at page 606, Annual Report of the Chief of Engineers for 1884, and page 824 of the Annual Report for 1893; and a later more detailed plan in House Ex. Doc. No. 86, Fiftieth Congress, first session; and further information at page 373 of the Annual Report for 1880, page 519 of the Annual Report for 1888, and page 823 of the Annual Report for 1893.

Amount expended and results to June 30, 1896.—The total amount expended up to June 30, 1896, was $175,929.77. The $63,000 appropriated from 1870 to 1879 secured a depth of 9 feet at high water up to the head of navigation. (See p. 375, Annual Report for 1880.) By the expenditure of the subsequent appropriations the greater portion of the proposed work had been completed, so there was a fairly good channel with a minimum depth of 11 feet at high water from the head of navigation to Narragansett Bay, but small amounts of dredging at points along the river and the removal of a few bowlders were still needed to secure the projected width and depth of the channel throughout its length.

Operations during the past fiscal year.—The amount expended during the past fiscal year was $4,580.34.

A contract for about $4,000 worth of dredging under the 1896 appropriation was entered into with The Hartford Dredging Company, of Hartford, Conn., under date of September 14, 1896, at the rate of $1.18 per cubic yard.

Work was commenced by the contractor in September and finished in October, 1896, removing 3,355 cubic yards of material from near the mouth of Three Mile River and in the Needles, completing all work under the contract, and widening and deepening the channel to full dimensions down to the lower end of the Needles, where a small amount of dredging still remains to be done.

This work was in the local charge of Mr. Edward Parrish, as assistant engineer, with Mr. Theo. McMahan and Mr. J. H. Rostock as inspectors.

Work required to complete the existing project.—There remains to complete the existing project the widening and deepening of the channel at the lower end of the Needles and at a few points below, and the removal of a small amount of ledge rock.

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Operations contemplated for the fiscal year ending June 30, 1898.—It is proposed to continue the widening and deepening of the channel at the narrow and shoal places.

Taunton River is in the Fall River collection district. Fall River is the nearest port of entry. The amount of revenue collected at Fall River in the last calendar year was $35,660.66. The nearest light-house is the Borden Flat light-house. The nearest fortification is Fort Adams, Newport Harbor, Rhode Island.

Money statement.

July 1, 1896, balance unexpended	$5,070.23
June 30, 1897, amount expended during fiscal year	4,580.34
July 1, 1897, balance unexpended	489.89
Amount (estimated) required for completion of existing project	7,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	7,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

AMOUNTS APPROPRIATED.

Previous projects.

July 11, 1870	$10,000	March 3, 1875	$10,000
March 3, 1871	10,000	June 18, 1878	2,000
June 10, 1872	10,000	March 3, 1879	1,000
March 3, 1873	10,000		
June 23, 1874	10,000	Total	63,000

Present project.

July 14, 1880	$17,500	July 13, 1892	$7,000
March 3, 1881	25,000	August 17, 1894	5,000
August 2, 1882	25,000	June 3, 1896	5,000
July 5, 1884	26,500		
September 19, 1890	7,000	Total	118,000

Abstract of proposal received and opened August 29, 1896, by Maj. D. W. Lockwood, Corps of Engineers, for dredging for improving Taunton River, Massachusetts.

No.	Name and address of bidder.	Rate per cubic yard.
1	The Hartford Dredging Co., Hartford, Conn	$1.18

Contract awarded to the Hartford Dredging Company.

Contract in force.

Contractor.	Date of approval.	To commence.	To complete.
The Hartford Dredging Co	Oct. 16, 1896	Oct. 1, 1896	Dec. 31, 1896

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COMMERCIAL STATISTICS.

The commerce arriving and leaving Taunton River, Massachusetts, by water during the calendar years ending December 31, 1891–1896, is estimated as follows (based mainly upon reports received from the Staples Coal Company, Taunton, Mass.):

Class of goods.	1891.	1892.	1893.	1894.	1895.	1896.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Cotton and products	8,750	8,800	6,600	8,750	9,188	8,500
Grains and forage	47,300	47,000	35,500	47,300	49,665	47,000
Lumber and products	20,400	21,000	16,000	21,000	22,050	24,000
Coal, minerals, and products	385,000	385,000	289,000	390,000	409,500	416,000
General merchandise	9,200	92,000	7.000	.....	.....	500
Sundries	.....	.....	.....	10,000	10,500	10,000
Total	470,650	553,800	354,100	477,050	500,903	500,000

New transportation companies established during the year, none.

The vessels entering and leaving this waterway are as follows (each entrance and departure together being counted as one):

Character or class of service.	Number.	Average draft.	Average tonnage.
		Feet.	*Tons.*
Steam (tugs)	400	7	50
Sail (freight)	750	9	200
Barges	600	9	900

C 9.

IMPROVEMENT OF SAKONNET RIVER, RHODE ISLAND.

The Sakonnet River is an arm of the sea between the island of Rhode Island and the mainland, extending from the ocean to Narragansett Bay around the head of Rhode Island. The entrance from the ocean is unobstructed, and formerly the entire river from Narragansett Bay to the ocean was navigable for the largest ships.

At present the upper end of the river is obstructed by two bridges or causeways, the northern one belonging to the New York, New Haven and Hartford Railroad Company and the other owned by the State of Rhode Island. These causeways have draws of insufficient capacity, and the approved project of July, 1896, proposed to increase the width and depth of the draw opening through the causeway owned by the State from 35 feet, present width, to 100 feet; and from 9 feet, present depth, to 25 feet at mean low water.

For fuller description of the subject, see Report of the Chief of Engineers for 1895, pages 729 to 737.

No work has been done and no funds expended during the past fiscal year, owing to the fact that the State assembly's permission to the United States to widen and deepen the draw opening in its bridge is conditioned in such a way as to make it inoperative until the railroad company shall have widened and deepened the draw opening of its bridge.

Sakonnet River is in the collection district of Newport, which is a port of entry. The amount of revenue collected at Newport in the last calendar year was $190.45. The nearest light-houses are Muscle Bed Shoals, Bristol Ferry, and Warwick light-houses. The nearest fortification is Fort Adams, R. I.

Money statement.

July 1, 1896, balance unexpended	$20,000.00
July 1, 1897, balance unexpended	20,000.00
Amount (estimated) required for completion of existing project	20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

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COMMERCIAL STATISTICS.

The commerce arriving and leaving Sakonnet River, Rhode Island, by water during the calendar year ending December 31, 1896, is estimated as follows (based mainly upon reports received from Mr. J. A. Pettey, general manager of the Sakonnet Steamboat Company):

	Tons.
Grains and forage	2,100
Vegetables and truck	10
Live stock and products	25
Fish, oysters, etc	200
Lumber and products	350
Coal, minerals, etc	650
Fertilizers	5
Machinery	5
General merchandise	300
Sundries	15
Total	3,660

New transportation companies established during the year, none.

The vessels entering and leaving this waterway are as follows (each entrance and departure together being counted as one):

Character or class of service.	Number.	Average draft.	Average tonnage.
		Feet.	*Tons.*
Steam:			
Freight and passenger	300	6	100
Passenger mainly	100	6	100
Fishing	200	6.5	80
Tugs	10	7	90
Pleasure boats	15	7	100
Sail:			
Fishing boats	200	3	4
Pleasure boats, large	4	8	80
Pleasure boats, small	300	3	2

C 10.

IMPROVEMENT OF PAWTUCKET RIVER, RHODE ISLAND.

The navigable part of the Pawtucket (or Seekonk) River, an arm of Providence River, extends from Providence to Pawtucket, a city which in 1890 had a population of about 28,000 and extensive manufactures, depending largely on water transportation. The mean rise and fall of the tide is about 5 feet.

Original condition.—Before improvement the channel in the river was narrow and had a ruling depth of about 5 feet at mean low water.

At the adoption of the present project the channel was narrow and only about 7 feet deep.

Plan of improvement.—The present approved project, that of 1883, provides for the deepening of the river so as to secure a channel of at least 12 feet depth at low water with 100 feet width from its mouth at Providence up to opposite Grant & Co.'s wharf, at Pawtucket, and thence 12 feet depth with 40 feet width through a stone ledge for a short distance toward Division Street Bridge; all at a total cost estimated in 1883 at $382,500.

A plan of the works may be found at page 608, Annual Report of the Chief of Engineers for 1884, and page 830 of 1893.

Amount expended and results to June 30, 1896.—The total amount expended up to June 30, 1896, was $248,776.07.

The $52,000 appropriated between 1867 and 1882 had dredged the channel to 75 feet width and 7 feet depth at low water. This work was completed in 1876.

The expenditure of subsequent appropriations had dredged the

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channel to 100 feet width and 12 feet depth as far as projected, and removed about two-thirds of the ledge from the channel 40 feet wide and 12 feet deep in front of the wharves in Pawtucket. A small amount of dredging had also been done between the piers of Central or Red Bridge, near the lower end of the improved channel, while the city of Providence was rebuilding the bridge, making the water there 20 feet deep and largely increasing the waterway through it.

The main channel has somewhat filled up near its banks.

Operations during the past fiscal year.—The amount expended during the past fiscal year was $5,172.32.

At the beginning of the fiscal year the two contracts with Messrs. Rogers & Fitzpatrick for removing ledge rock described at page 677, Annual Report of the Chief of Engineers for 1895, were in force, but no work having been done by them from June 19, 1896, to September 20, 1896, both contracts were canceled. However, under date of January 7, 1897, the Secretary of War directed that the time for completion of these contracts be extended to April 1, 1897, and work was resumed in February and completed in March, 1897, by the removal of 256.28 cubic yards of material, completing the lower section of the channel through the ledge rock to its full dimensions of 40 feet width and 12 feet depth at mean low water.

A contract for removing about 1,300 cubic yards of ledge rock under the 1896 appropriation was entered into on April 14, 1897, with John J. Fitzpatrick, of Plattsburg, N. Y., at $6.66 per cubic yard. Under the provisions of this contract work was commenced in April, 1897, and was in progress at the close of the fiscal year. Drilling and blasting had been carried on over about one-half of the upper section of the channel, but no rock had been removed.

This work was under the local charge of Mr. Edward Parrish as assistant engineer, with Mr. John F. Parks as inspector.

Work required to complete the existing project.—The work yet to be done is to straighten the channel in the lower part of the river and to deepen it at points where it has shoaled and through the ledge to the full depth of 12 feet and width of 40 feet.

Operations contemplated for the fiscal year ending June 30, 1898.—It is proposed to apply the balance of funds on hand toward both the removal of the ledge and the straightening and deepening of the channel in its lower portions.

Pawtucket is in the collection district of Providence, and that port is the nearest port of entry. The amount of revenue collected at Providence in the last calendar year was $194,558.97. The nearest light-house is Sassafras Point Light. The nearest fortifications are Fort Adams, Newport, R. I., and the fort on Dutch Island, Rhode Island.

Money statement.

July 1, 1896, balance unexpended		$28,723.93
From sales		19.59
		28,743.52
June 30, 1897, amount expended during fiscal year		5,172.32
July 1, 1897, balance unexpended		23,571.20
July 1, 1897, outstanding liabilities	$175.50	
July 1, 1897, amount covered by uncompleted contracts	8,658.00	
		8,833.50
July 1, 1897, balance available		14,737.70
Amount (estimated) required for completion of existing project		157,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

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AMOUNTS APPROPRIATED.

March 2, 1867	$17,000.00	July 13, 1892	$35,000.00
July 11, 1870	8,000.00	August 17, 1894	25,000.00
March 3, 1871	7,000.00	June 3, 1896	20,500.00
June 10, 1872	10,000.00		
March 3, 1873	10,000.00	Total	277,500.00
July 5, 1884	50,000.00	Received from sale of material	19.59
August 5, 1886	30,000.00		
August 11, 1888	35,000.00	Total	277,519.59
September 19, 1890	30,000.00		

Abstract of proposals received and opened March 25, 1897, by Maj. D. W. Lockwood, Corps of Engineers, for removing ledge rock for improving Pawtucket River, Rhode Island.

No.	Name and address of bidder.	Rate per cubic yard.
1	Robt. H. Rogers, Plattsburg, N. Y.	$7.6949
2	Chas. W. Johnston, Philadelphia, Pa.	11.00
3	John J. Fitzpatrick, Plattsburg, N. Y.	6.66
4	Hiram W. Phillips, Quincy, Mass.	10.45
5	Frank Pidgeon, Saugerties, N. Y.	8.39

Contract awarded to John J. Fitzpatrick.

Contracts in force.

Contractors.	Date of approval.	To commence.	To complete.
Rogers & Fitzpatrick	Aug. 22, 1894	Aug. 25, 1894	Feb. 1, 1895.*a*
Do	Apr. 12, 1895	May 1, 1895	Jan. 1, 1896.*a*
John J. Fitzpatrick	May 22, 1897	May 1, 1897	Oct. 1, 1897.

a Extended to April 1, 1897.

COMMERCIAL STATISTICS.

The commerce arriving and leaving Pawtucket River, Rhode Island, by water during the calendar years ending December 31, 1891–1896, is estimated as follows (based mainly upon reports received from the Newell Coal and Lumber Company, of Pawtucket, R. I.):

Class of goods.	1891.	1892.	1893.	1894.	1895.	1896.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Cotton and products	625	620	700	.....	.....	.....
Lumber and products	9,365	16,700	14,500	12,600	8,620	9,000
Coal, minerals, etc.	174,860	221,000	168,000	158,000	175,447	175,000
Fertilizers	1,600	1,600	1,433	7,000	1,099	1,000
General merchandise	.....	.....	.....	5,850	10,308	11,500
Sundries	.....	.....	2,000	.....	.....	5,000
Total	186,450	249,900	186,633	183,450	195,474	201,500

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New transportation companies established during the year, none reported.

The vessels entering and leaving this waterway are as follows (each entrance and departure together being counted as one):

Character or class of service.	Number.	Average draft.	Average tonnage.
		Feet.	*Tons.*
Steam:			
Freight, mainly	250	10	500
Passenger, mainly	275	8	100
Tugs	500	7	80
Miscellaneous	125	5	50
Sail:			
Freight	175	10	300
Pleasure boats, large	20	7	100
Pleasure boats, small	300	3	4
Barges	100	10	500

C 11.

IMPROVEMENT OF PROVIDENCE RIVER AND NARRAGANSETT BAY, RHODE ISLAND.

Providence River is an estuary of Narragansett Bay. The object of its improvement is to furnish a wide and deep channel for European and coastwise commerce from the ocean to Providence, a city which had in 1890 about 132,000 inhabitants, being twenty-fifth in size of the cities of the United States, a city largely engaged in manufactures, and also a port of entry for an extensive region of country with which it is connected by railroads. The mean rise and fall of the tide is 4.7 feet.

Original condition.—Before the improvement of the river was commenced in 1853 many shoals obstructed navigation, and at one point in the channel, a place called The Crook, the available low-water depth was but 4.5 feet.

Plans of improvement.—The projects between 1852 and 1873 provided for deepening the channel by removing obstructing rocks and dredging at the shoalest points to secure first a depth of 9 feet and then 12 feet. This work was completed in 1878. The project of 1878 as modified in 1882 provided for a channel 300 feet wide and 25 feet deep from Providence to the deep water of Narragansett Bay and for an anchorage basin between Fox Point and Fields Point, with a depth of 20 feet 600 feet wide, a depth of 18 feet 725 feet wide, a depth of 12 feet 940 feet wide, and a depth of 6 feet 1,060 feet wide; all at a total estimated cost in 1882 of $675,000. The 25-foot channel of this project has been laid out in straight reaches (with enlargements at the angles), with a view to their being lighted later, if it should be found necessary, by range or leading lights, such as are used in similar cases in Chesapeake Bay, Delaware River, and other localities.

The river and harbor act of June 3, 1896, provides for securing a ship channel 400 feet in width and of a depth of 25 feet at mean low water from Sassafras Point, in Providence Harbor, through Providence River and Narragansett Bay, by the most direct route practicable to the ocean by way of the "Western Passage," so called, at an estimated cost of $732,820.

A plan of the old works may be found at page 622, Annual Report of the Chief of Engineers for 1884, and page 830 of 1893, and further special information at page 235 of 1878 and page 557 of 1882.

Amount expended and results to June 30, 1896.—The amount expended up to June 30, 1896, was $686,728.14, by which a channel 300 feet wide and 25 feet deep had been secured up to the city of Providence, Bulkhead Rock had been removed, and an anchorage area 1,060 feet wide with depths varying from 6 to 20 feet had been dredged between Fields Point and Fox Point; but both the channel and anchorage area have shoaled considerably in places and need some redredging.

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Operations during the past fiscal year.—The amount expended during the past fiscal year was $11,762.46.

No work was in progress at the commencement of the fiscal year. A survey of the river between Sassafras and Conimicut points was made in October, 1896, for securing data for dredging under the appropriation of 1896.

A continuous contract was entered into on February 26, 1897, with Mr. P. Sanford Ross, of Jersey City, N. J., at 8⅞ cents per cubic yard, for removing about 1,122,000 cubic yards of material between those points. Under this agreement the contractor commenced work in April, 1897, which was in progress at the end of the fiscal year. One hundred and forty-five thousand three hundred and seventy-two cubic yards of material were removed from the channel between Sassafras Point and Pomham Rocks.

This work was under the local charge of Mr. Edward Parrish as assistant engineer, with Messrs. T. W. Kennan, John F. Parks, Philip S. Knauer, and Hugh D. Rose as inspectors. The survey was under the charge of Mr. C. M. Winchell, assistant engineer.

Work required to complete the existing project.—The river and harbor act of June 3, 1896, contained the following provision:

Improving Providence River and Narragansett Bay, Rhode Island: Continuing improvement, according to the report of the Chief of Engineers, dated April ninth, eighteen hundred and ninety-six, twenty-five thousand dollars: *Provided*, That contracts may be entered into by the Secretary of War for such materials and work as may be necessary for the completion of such project, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate seven hundred and seven thousand dollars, exclusive of the amount herein and heretofore appropriated.

Under the provisions of this act a project was submitted and approved under date of August 13, 1896, for dredging a channel 400 feet wide and 25 feet deep at mean low water from Sassafras Point to Conimicut Point, and this constitutes the project in force at the present time. A contract is in force with Mr. P. Sanford Ross, and the dredge is now about one-third of the distance between Fields Point and Pomham below the former place, leaving the channel from there to Conimicut Point to be completed.

Operations contemplated for the fiscal year ending June 30, 1898.—It is proposed to continue the work of dredging in the proposed new ship channel.

Providence River is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence in the last calendar year was $194,558.97. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are fort on Dutch Island and Fort Adams, R. I.

Money statement.

July 1, 1896, balance unexpended		$29,771.86
Received from sale of material		143.39
Amount appropriated by sundry civil act approved June 4, 1897		125,000.00
		154,915.25
June 30, 1897, amount expended during fiscal year		11,762.46
July 1, 1897, balance unexpended		143,152.79
July 1, 1897, outstanding liabilities	$6,715.26	
July 1, 1897, amount covered by uncompleted contracts	7,098.23	
		13,813.49
July 1, 1897, balance available		129,339.30
Amount (estimated) required for completion of existing project		582,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

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AMOUNTS APPROPRIATED.

August 30, 1852	$5,000.00	July 5, 1884	$85,000.00
August 30, 1852 (survey)	1,500.00	August 5, 1886	30,000.00
May 2, 1867	25,000.00	August 11, 1888	40,000.00
July 11, 1870	5,000.00	September 19, 1890	50,000.00
July 15, 1870	2,500.00	July 13, 1892	50,000.00
June 10, 1872	10,000.00	August 17, 1894	17,500.00
March 3, 1873	10,000.00	June 3, 1896	25,000.00
June 18, 1878	5,000.00	June 4, 1897	125,000.00
June 18, 1878	50,000.00		
March 3, 1879	60,000.00	Total	841,500.00
July 14, 1880	60,000.00	Received from sale of material	143.39
March 3, 1881	60,000.00		
August 2, 1882	125,000.00	Total	841,643.39

Abstract of proposals received and opened February 15, 1897, at office of Maj. D. W. Lockwood, Corps of Engineers, for dredging for improving Providence River and Narragansett Bay, Rhode Island.

No.	Name and address of bidder.	Rate per cubic yard.
		Cents.
1	R. G. & J. S. Packard, New York, N. Y.	10
2	The Hartford Dredging Co., Hartford, Conn.	14
3	Alabama Dredging and Jetty Co., Mobile, Ala.	11.9
4	P. Sanford Ross, Jersey City, N. J.	8⅞
5	Columbia Dredging Co., Fall River, Mass.	11.9
6	M. J. Fenton & Co., New York, N. Y.	16½
7	Elijah Brainard, New York, N. Y.	9.7

Contract awarded to P. Sanford Ross.

Contract in force.

Contractor.	Date of approval.	To commence.	To complete.
P. Sanford Ross	Mar. 10, 1897	Apr. 1, 1897	July 1, 1899

COMMERCIAL STATISTICS.

The commerce arriving and leaving Providence River, Rhode Island, by water, during the calendar years ending December 31, 1893–1896, is estimated as follows (based mainly upon reports received from Mr. George H. Webb, secretary of the board of trade, Providence, R. I.):

Class of goods.	1893.	1894.	1895.	1896.
	Tons.	*Tons.*	*Tons.*	*Tons.*
Grains and forage	.....	.....	20,079	19,509
Lumber and products	46,000	60,000	47,503	46,500
Coal, minerals, and products	600,000	1,051,000	1,288,301	1,108,975
Fertilizers	1,400	2,000	366	375
General merchandise	521,700	521,700	373,694	375,600
Sundries	2,000	9,000	23,063	50,000
Total	1,171,100	1,643,700	1,753,006	1,600,950

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New transportation companies established during the year, none reported.

The vessels entering and leaving this waterway are as follows (each entrance and departure together being counted as one):

Character or class of service.	Number.	Average draft.	Average tonnage.
		Feet.	*Tons.*
Steam:			
Freight and passenger	1,431	18	450
Freight mainly	1,840	20	600
Passenger mainly	1,320	7	300
Fishing	635	3	10
Tugs	5,500	7	150
Pleasure boats	1,750	5	50
Sail:			
Freight	3,680	15	400
Pleasure boats, large	400	7	40
Pleasure boats, small	2,000	3	7
Barges	750	15	1,000

C 12.

IMPROVEMENT OF GREEN JACKET SHOAL, PROVIDENCE RIVER, RHODE ISLAND.

Green Jacket Shoal is that part of Providence River which lies off the wharves on the south front of the city of Providence, being an important part of the harbor for anchorage purposes.

Original condition.—That part of the harbor in which the shoal is located is about 2,000 feet long by from 600 to 1,200 feet wide; and of this area, the shoal occupied about 30 acres, that part of it which was included between the 15-foot curves measuring about 18 acres. There were channels on either side of the shoal, between it and the harbor lines, having at mean low water a width of 300 feet and a depth of 20 feet on the north side, and a width varying from 50 to 100 feet and a depth of about 15 feet on the south side. The water on the summit of the shoal was only 1 foot deep.

Plan of improvement.—The present approved project, that of 1885, provides for the removal to 25 feet depth at low water of a middle-ground shoal of about 30 acres area in Providence River opposite the city, no portion of the shoal within 200 feet of the harbor lines of the city to be removed by the General Government; all at a total cost estimated in 1885 at $112,346.

A plan of the works may be found at page 598, Annual Report of the Chief of Engineers for 1885, and pages 830 and 832 of 1893.

Amount expended and results to June 30, 1896.—The total amount expended on the present project up to June 30, 1896, was $95,983.19, by which 22 acres (out of the original 30) had been dredged to 25 feet depth and a 16-foot depth had been secured over the remaining central and largest portion of the shoal, making an important addition to the anchorage facilities of the harbor.

Operations during the past fiscal year.—The amount expended during the past fiscal year was $7,913.80.

A contract for dredging under the 1896 appropriation was entered into on September 12, 1896, with Messrs. R. G. & J. S. Packard, of New York, N. Y., at the rate of 18 cents per cubic yard.

The work of dredging under the above contract was commenced September 18 and completed October 9, 1896. Thirty-nine thousand nine hundred and fifty-one cubic yards of material were removed, adding about 1.8 acres to the deepened area.

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This work was under the local charge of Mr. Edward Parrish as assistant engineer, with Mr. John F. Parks and Mr. J. T. P. Bucklin as inspectors.

Work required to complete the existing project.—The work required to complete the existing project is the further deepening of the entire area to its full depth of 25 feet.

Operations contemplated for the fiscal year ending June 30, 1898.—Nothing contemplated, there being no funds available.

Green Jacket Shoal is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence during the last calendar year was $194,558.97. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are Fort Adams, R. I., and the fort on Dutch Island.

Money statement.

July 1, 1896, balance unexpended	$8,266.81
June 30, 1897, amount expended during fiscal year	7,913.80
July 1, 1897, balance unexpended	353.01
July 1, 1897, outstanding liabilities	20.75
July 1, 1897, balance available	332.26
Amount (estimated) required for completion of existing project	8,096.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	8,096.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

AMOUNTS APPROPRIATED.

Present project.

August 5, 1886	$26,250	August 17, 1894	$7,500
August 11, 1888	28,000	June 3, 1896	7,500
September 19, 1890	25,000		
July 13, 1892	10,000	Total	104,250

Abstract of proposal received and opened August 29, 1896, by Maj. D. W. Lockwood, Corps of Engineers, for dredging for removing Green Jacket Shoal, Providence River, Rhode Island.

No.	Name and address of bidder.	Rate per cubic yard.
1	R. G. & J. S. Packard, New York, N. Y.	$0.18

Contract awarded to R. G. & J. S. Packard.

Contract in force.

Contractor.	Date of approval.	To commence.	To complete.
R. G. & J. S. Packard	Sept. 23, 1896	Oct. 1, 1896	Dec. 31, 1896

For the commercial statistics, see report for improvement of Providence River and Narragansett Bay, Rhode Island.

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C 13.

IMPROVEMENT OF WICKFORD HARBOR, RHODE ISLAND.

Wickford Harbor is an arm of Narragansett Bay lying west of the north end of Conanicut Island, about 18 miles south of Providence and about 12 miles northwest of Newport, R. I. The entrance is obstructed by a number of bowlders and the harbor itself is shoal.

The harbor owes its importance to the fact that it is the water terminus of the Wickford Railroad, which connects with the New York, New Haven and Hartford Railroad at Wickford Junction, and, in connection with a ferryboat making six round trips daily between Wickford and Newport, forms the shortest line of communication between the latter point and New York and other points west.

The mean rise and fall of the tide is 4.2 feet.

Original condition.—Before improvement the channel had a ruling depth of about 6 feet at mean low water.

At the adoption of the present project the channel, extending from the steamboat wharf near the entrance to the harbor up to the wharves of the town of Wickford, was winding and about 6 feet deep, and the entrance to the harbor and the channel were obstructed by bowlders.

Plan of improvement.—The project of 1896 provides for removing certain of the worst bowlders and dredging a channel 60 feet wide and 9 feet deep at mean low water with enlargements at the bends up to the wharves in Wickford.

Amount expended and results to June 30, 1896.—The amount expended up to June 30, 1896, was $10,000, which removed some of the bowlders from the entrance to the harbor and gave a fair channel of 9 feet depth at mean low water up to the steamboat wharf.

Operations during the past fiscal year.—The amount expended during the past fiscal year was $5,563.89.

A contract for about $5,000 worth of dredging and removing bowlders was entered into with the Hartford Dredging Company, of Hartford, Conn., under date of September 26, 1896, at 15.7 cents per cubic yard for dredging and $16.50 per cubic yard for bowlders. Under the provisions of this contract work was commenced in September and completed in December, 1896. Thirty thousand two hundred and sixty-five cubic yards of material were dredged and two-thirds of a cubic yard of bowlders removed, resulting in completing the channel to the depth and width projected.

This work was in the local charge of Mr. Edward Parrish as assistant engineer, with Mr. T. W. Kennan and Mr. Thomas J. Peirce as inspectors.

Operations contemplated for the fiscal year ending June 30, 1898.—It is proposed to apply the funds available to removing a few additional bowlders.

Wickford is in the collection district of Newport. The amount of revenue collected at Newport in the last calendar year was $190.45. The nearest light-house is Wickford Harbor Light. The nearest fortification is fort on Dutch Island, Rhode Island.

Money statement.

July 1, 1896, balance unexpended	$6,300.00
June 30, 1897, amount expended during fiscal year	5,563.89
July 1, 1897, balance unexpended	736.11

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AMOUNTS APPROPRIATED.

March 3, 1873	$5,000
June 23, 1874	5,000
July 1, 1896	6,300
Total	16,300

Abstract of proposals received and opened September 4, 1896, at office of Maj. D. W. Lockwood, Corps of Engineers, for dredging for improving harbor at Wickford, R. I.

No.	Name and address of bidder.	Rate per cubic yard.	
		Dredging.	Bowlders.
		Cents.	
1	Hartford Dredging Co., Hartford, Conn	15.7	$16.50
2	Thos. A. Scott, New London, Conn	23	15.00
3	Simon C. Fraser, New London, Conn	24	10.00
4	Elijah Brainard, New York, N. Y	12	25.00

Contract awarded to The Hartford Dredging Company.

Contract in force.

Contractor.	Date of approval.	To commence.	To complete.
The Hartford Dredging Co	Oct. 16, 1896	Oct. 1, 1896	Dec. 31, 1896

COMMERCIAL STATISTICS.

The commerce arriving and leaving Wickford Harbor, Rhode Island, by water during the calendar year ending December 31, 1896, is estimated as follows (based mainly upon reports received from Mr. Thomas J. Peirce, town clerk, Wickford, R. I.):

	Tons.
Cotton and products	100
Tobacco	10
Rice	4
Grains and forage	750
Vegetables and truck	25
Live stock and products	125
Fish, oysters, etc	475
Naval stores	6
Lumber and products	2,014
Coal, minerals, etc	11,100
Fertilizers	50
General merchandise	200
Sundries	50
Total	14,909

New transportation companies established during the year, none.

The vessels entering and leaving this waterway are as follows (each entrance and departure together being counted as one):

Character or class of service.	Number.	Average draft.	Average tonnage.
		Feet.	*Tons.*
Steam:			
Freight and passenger	1,200	7	332
Fishing	50	6	50
Tugs	150	7	80
Pleasure boats	250	65	85
Sail:			
Freight	113	7	300
Fishing boats	250	3	5
Pleasure boats, large	75	7	50
Pleasure boats, small	200	3	2
Barges	4	11	600

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C 14.

IMPROVEMENT OF NEWPORT HARBOR, RHODE ISLAND.

Newport Harbor is at the main entrance to Narragansett Bay. This bay during the entire year offers an easily accessible harbor of refuge for our European and coastwise commerce quite equal in almost every respect to any harbor on this coast. Newport Harbor, lying at the eastern entrance to this bay and forming a part of it, has been used by vessels from very early times on account of its accessibility and well-sheltered location.

The objects of the improvement are to widen and deepen the entrance to the harbor and to enlarge its capacity for vessels seeking refuge in storms by increasing the area and depth of the anchorage within it. The mean rise and fall of the tide is about 3.75 feet.

Original condition.—Before improvement, the capacity of the inner harbor was limited by shoals, and it was not sufficient for the vessels seeking it for refuge. The southern (main) entrance was obstructed by a bar which stretched out from Goat Island, and the northern entrance, near Rose Island, by a sharp rocky spit, and the general business wharves of the city could not be reached at low tide by vessels drawing more than 8 feet.

At the adoption of the present project this harbor was limited to 12 feet depth at low water, and its anchorage area too small for the craft seeking harborage at this place during the summer and all the year during storms.

Plan of improvement.—The present approved project, that of 1880, as modified in 1882, 1883, 1884, 1890, and 1895, provides for the widening and deepening of the channel from Narragansett Bay into Newport, so as to secure 15 feet depth at low water, with at least 750 feet width; for the extension of the 13-foot depth and 10-foot depth anchorage basins and for dredging a channel 10 feet deep along the harbor line south from Commercial wharf to a point opposite the gas company's wharf; for the partial cutting off of the shoal spit at the southern end of Goat Island, and for the construction of jetties on the western shore of Goat Island, so as to protect the end of this island from erosion, and to prevent the drift of sand, etc., around the island into the adjacent parts of the channel and harbor, and for the removal of "Spindle Rock," a sharp rocky spit near Rose Island; all at a total cost estimated in 1895 at $206,200.

A plan of the works may be found at page 604, Annual Report of the Chief of Engineers for 1885, and page 838 of 1893; and further details at page 562 of 1881, page 561 of 1882, page 494 of 1883, page 624 of 1884, page 736 of 1891, and page 627 of 1892.

Amount expended and results to June 30, 1896.—The amount expended to June 30, 1896, was $160,224.86. The $28,500 appropriated between 1873 and 1875 had been expended in dredging a 12-foot channel up to the city wharves and in building a small jetty to arrest the flow of sand into the main channel and harbor, and to protect the western side of Goat Island. This work was completed in 1876. Of the work under the present project, the 15-foot depth channel at the southern entrance to the harbor, the 10-foot depth channel along the harbor line south from Commercial wharf to a point opposite the gas company's wharf, the cutting off of the spit at the southern end of Goat Island, and a jetty on the western side of the island had been nearly completed. The 13-foot depth anchorage area had been completed, with the exception of a small shoal spot of hard material near its western side, and a small

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part of the 10-foot anchorage area had been dredged, and 194 cubic yards of rock had been removed from Spindle Rock.

Operations during the past fiscal year.—The amount expended during the past fiscal year was $20,198.94.

The contract for removing "Spindle Rock," near Rose Island, in progress at the beginning of the fiscal year, was completed in September, 1896, by the removal of 215.14 cubic yards of rock, securing a depth of 8.5 feet at low water over the remaining portions of the rock. This completed all contract work under the 1894 appropriation. For method of work employed by the contractor, see Annual Report of the Chief of Engineers for 1896, Part I, page 652.

Proposals were invited by public advertisement for completing the dredging at the southern end of Goat Island. The first proposal received for dredging under the 1896 appropriation was rejected as being excessive. The work was readvertised and a contract for about $13,000 worth of dredging was entered into with the Hartford Dredging Company, of Hartford, Conn., under date of November 6, 1896, at the rate of 37 cents per cubic yard. Dredging was commenced by the contractors in November, 1896, and completed in February, 1897. Thirty-eight thousand seven hundred and fifteen cubic yards of material were removed, completing all contract work, and widening and deepening the channel around the southern end of Goat Island to full width and depth.

This work was under the local charge of Mr. Edward Parrish, as assistant engineer, with Mr. T. W. Kennan and Mr. C. O. Adell as inspectors.

Work required to complete the existing project.—The work required to complete the existing project is the excavation of the remainder of the 10-foot anchorage area within the harbor and the building of additional jetties outside of Goat Island, whenever they may be required to arrest the drift of littoral sand and gravel into the harbor entrance.

Operations contemplated for the fiscal year ending June 30, 1898.—Nothing contemplated, there being no funds available.

Newport is in the collection district of Newport, and is a port of entry. The amount of revenue collected at Newport in the last calendar year was $190.45. The nearest light-houses are Lime Rock and Newport (Goat Island) lights. The nearest fortification is Fort Adams, R. I.

Money statement.

July 1, 1896, balance unexpended	$20,276.14
From sales	8.52
	20,284.66
June 30, 1897, amount expended during fiscal year	20,198.94
July 1, 1897, balance unexpended	85.72
Amount (estimated) required for completion of existing project	54,200.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	54,200.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

AMOUNTS APPROPRIATED.

March 3, 1873	$8,500.00	September 19, 1890	$12,500.00
June 23, 1874	10,000.00	July 13, 1892	25,000.00
March 3, 1875	10,000.00	August 17, 1894	7,500.00
March 3, 1881	25,000.00	June 3, 1896	15,000.00
August 2, 1882	20,000.00	Received from sale of material	8.52
July 5, 1884	20,000.00		
August 5, 1886	15,000.00	Total	180,508.52
August 11, 1888	12,000.00		

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Abstract of proposal received and opened September 4, 1896, at office of Maj. D. W. Lockwood, Corps of Engineers, for dredging for improving harbor at Newport, R. I.

No.	Name and address of bidder.	Rate per cubic yard.
1	Columbia Dredging Co., Fall River, Mass	$0.54

Bid rejected as exorbitant.

Abstract of proposals received and opened October 21, 1896, by Maj. D. W. Lockwood, Corps of Engineers, for dredging for improving harbor at Newport, R. I.

No.	Name and address of bidder.	Rate per cubic yard.
		Cents.
1	The Hartford Dredging Co., Hartford, Conn	37
2	R. G. Packard, New York, N. Y	57.5
3	The Columbia Dredging Co., Fall River, Mass	53.5

Contract awarded to the Hartford Dredging Company.

Contracts in force.

Contractor.	Date of approval.	To commence.	To complete.
James S. Rogers	Aug. 7, 1895	Sept. 1, 1895*a*	Dec. 1, 1895*b*
Hartford Dredging Co	Nov. 12, 1896	May 1, 1897	Sept. 1, 1897

a Extended to April 1, 1896. *b* Extended to October 1, 1896.

COMMERCIAL STATISTICS.

The commerce arriving and leaving Newport Harbor, Rhode Island, by water during the calendar years ending December 31, 1891–1896, is estimated as follows (based mainly upon reports received from Martin H. Ball, deputy collector of customs, and other citizens of Newport, R. I.):

Class of goods.	1891.	1892.	1893.	1894.	1895.	1896.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Cotton and products	.....	150	150	150	175	150
Tobacco	.....	25	25	50	25	30
Grains and forage	8,500	4,000	2,000	1,000	850	1,500
Vegetables and truck	.....	400	400	600	10,535	12,000
Live stock and products	.....	70	70	2,400	40,281	45,000
Fish, oysters, etc	3,000	500	500	8,000	136,644	138,000
Naval stores	.....	.....	.....	80	1,239	1,200
Lumber and products	22,880	12,000	10,500	13,250	13,000	15,000
Coal, minerals, etc	83,400	53,300	95,500	75,000	50,000	75,000
Fertilizers	.....	2,400	1,400	125	250	300
Machinery	.....	300	425	.....	.....	200
General merchandise	37,000	15,000	15,000	15,000	121,152	125,000
Sundries	4,739	3,000	3,000	3,000	.....	500
Total	159,519	90,500	128,970	118,665	374,151	413,880

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New transportation companies established during the year, none reported.

The vessels entering and leaving this waterway are as follows (each entrance and departure being counted as one):

Character or class of service.	Number.	Average draft.	Average tonnage.
		Feet.	*Tons.*
Steam:			
Freight and passenger	1,300	12	1,500
Freight mainly	350	10	1,000
Passenger mainly	3,500	8	500
Fishing	300	7	100
Tugs	550	7	80
Pleasure boats	1,200	7	100
Sail:			
Freight	800	10	150
Fishing boats	600	6	15
Pleasure boats, large	1,500	6	10
Pleasure boats, small	2,400	3	3
Barges, freight	180	12	500

C 15.

HARBOR OF REFUGE AT POINT JUDITH, RHODE ISLAND.

Point Judith is the southeastern extremity of South Kingston, R. I., and marks the southwestern entrance to Narragansett Bay.

At the adoption of the present project this point was a specially dangerous place for boats and tows to pass during storms and even ordinarily bad weather.

Plan of improvement.—The present approved project, that of 1889, provides for the construction of a national harbor of refuge nearly a mile square at this point by means of stone breakwaters built partly on Squid Ledge and planned so as to give protection against easterly, southerly, and westerly storms, the mainland itself forming a protection on the north; all at a total cost estimated in 1889 at $1,250,000.

By the act of July 13, 1892, authority was given to the Secretary of War to make contracts for the completion of the project on the basis of the above estimated total cost, the work to be paid for as appropriations may from time to time be made by law.

A description of the works may be found at page 595, Annual Report of the Chief of Engineers for 1890, and a general plan of the same in House Ex. Doc. No. 66, Fifty-first Congress, first session, and page 840 of 1893.

Amount expended and results to June 30, 1896.—The total amount expended on the present project up to June 30, 1896, was $628,785.18, by which the breakwater had been commenced at its center, extended to a total length of about 5,560 feet, of which about 4,800 feet was well above the level of high water, and the greater part of this up to the full height of 10 feet above mean low water, but it all needed widening out and the building up of the outer slopes. Three beacon lights had been established and maintained thereon.

Operations during the past fiscal year.—The amount expended during the past fiscal year was $271,308.64.

The work of constructing the breakwater under the continuous contract with Messrs. Hughes Bros. & Bangs, of Syracuse, N. Y., in progress at the beginning of the fiscal year, was continued until October 30, 1896, when it was suspended for the winter. During the year 111,681 tons of stone were placed in the breakwater, making a total under the contract of 635,022, by which the eastern arm of the breakwater, 3,860 feet in length, was built up to its full height and width, but the sea slope of 1 on 2 was not yet completed.

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The storms during the past winter have carried off some of the top stones, but no serious damage has been done. On September 9, 1896, a severe gale, accompanied by an unusually high tide, visited this locality and caused considerable damage to the top of the breakwater. In consequence of the damage thus sustained a Board of Engineers was convened to consider and report upon the subject of the construction of the harbor of refuge at Point Judith, R. I. The report of this Board recommends the raising of the crest of the eastern arm of the breakwater to 9 feet above high water, the present height being 6 feet, and the postponement of the construction of the detached eastern breakwater until after the completion of the main work may demonstrate the necessity or otherwise of such a structure for additional shelter.

This work was under the local charge of Mr. Edward Parrish as assistant engineer, with Mr. John A. Dill as inspector.

Work required to complete the existing project.—The work required to complete the existing project is the buiding up and extension of the breakwater.

The completion of the project, as recommended by the Board of Engineers, involves the placing of 310,533 tons of stone, in addition to the amount covered by the existing contract, which it is estimated will cost $444,311.

Operations contemplated for the fiscal year ending June 30, 1898.—It is proposed to apply the available funds to continuing the construction of the breakwater.

Point Judith is in the collection district of Newport, which is a port of entry. The amount of revenue collected at Newport in the last calendar year was $190.45. The nearest light-house is Point Judith Light. The nearest fortification is the fort on Dutch Island, Rhode Island.

Money statement.

July 1, 1896, balance unexpended		$321,214.82
Received from sale of material		38.61
Amount appropriated by sundry civil act approved June 4, 1897		300,000.00
		621,253.43
July 30, 1897, amount expended during fiscal year		271,308.64
July 1, 1897, balance unexpended		349,944.79
July 1, 1897, outstanding liabilities	$20,314.50	
July 1, 1897, amount covered by uncompleted contracts	22,949.05	
		43,263.55
July 1, 1897, balance available		306,681.24
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		444,311.00

AMOUNTS APPROPRIATED.

September 19, 1890	$75,000.00
July 13, 1892	75,000.00
March 3, 1893	100,000.00
August 18, 1894	100,000.00
March 2, 1895	300,000.00
June 11, 1896	300,000.00
June 4, 1897	300,000.00
	1,250,000.00
Received from sale of material	38.61
Total	1,250,038.61

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Contract in force.

Contractor.	Date of approval.	To commence.	To complete.
Hughes Bros. & Bangs	Apr. 3, 1893	May 1, 1893	Indeterminate.

COMMERCIAL STATISTICS.

The tonnage of vessels passing Point Judith, Rhode Island, during the calendar years ending December 31, 1893–1896, is estimated as follows (based mainly on reports received from Mr. Asa Church, keeper Point Judith Life-Saving Station, Rhode Island):

Class of vessels.	1893.	1894.	1895.	1896.
	Gross tons.	*Gross tons.*	*Gross tons.*	*Gross tons.*
Steamers (freight and fish)	6,000,000	6,000,000	6,000,000	6,000,000
Yachts (steam and sail)	700,000	700,000	700,000	700,000
Schooners (2, 3, and 4 masts)	20,400,000	20,400,000	20,400,000	21,400,000
Ships, barks, and barkentines	180,000	180,000	180,000	180,000
Brigs and brigantines	60,000	60,000	60,000	60,000
Sloops	40,000	40,000	40,000	40,000
Barges	2,880,000	2,880,000	4,840,000	,000,000
Total	30,260,000	30,260,000	32,220,000	33,380,000

REPORT OF BOARD OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., October 23, 1896.

GENERAL: The Board of Engineers constituted by Special Orders No. 34, Headquarters, Corps of Engineers, United States Army, September 26, 1896, to consider and report upon the subject of the construction of the harbor of refuge at Point Judith, Rhode Island, has the honor to submit the following report:

The Board assembled at Newport, R. I., on October 20, 1896, and after a brief examination of the plans and records of the office proceeded to Point Judith harbor of refuge and examined the work there under construction and the surrounding locality.

The following day was devoted to a study of maps and records and a general discussion of the problem with the result that the Board finds:

(1) That during the recent storm, with the coincident extreme tide, the sheltered area was so disturbed as to be dangerous for small craft and not wholly safe for large ones.

(2) That this lack of shelter will probably be remedied by raising the crest to 9 feet at high water, as recommended by the division engineer.

(3) That such raising of the superstructure will strengthen it, even if stone of the same character now used be employed.

(4) That if future storms should indicate that the higher superstructure of the present sizes of stone is not strong enough, additional strength can be given by employing heavier stone and laying them with greater regularity than called for by present contract.

(5) That there is no indication that the part of the present structure below low water is inadequate.

From experience at other breakwaters, it is considered probable that an increase in the top width of the superstructure will not be necessary if the work is completed with very large stones laid carefully with their

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largest dimensions across the work. The exterior and interior slopes of the substructure should be such as may be formed by the action of the sea.

The Board is of the opinion that it is desirable to continue the construction of this breakwater in accordance with the present project, notwithstanding the fact that investigations with reference to further improvements in this vicinity have been provided for by Congress.

	Tons.
In addition to the present contract, it is estimated that there will be required to complete the project	421,328
The detached arm is estimated to require	130,795
Leaving for the main work	290,533
To raise the eastern arm to 13 feet above mean low water, with 20 feet width on top, will require	20,000
Total	310,533

In view of the expense involved in completing the main work and of raising a part of it (the eastern arm, as seems desirable) to the height proposed of 13 feet above mean low water, the Board is of the opinion that the construction of a detached arm off the eastern entrance, as a part of the main project, may safely be deferred until the completion of the main work may demonstrate the necessity or otherwise of such a structure for additional shelter. This course seems all the more desirable in view of the fact that such a structure would necessarily interfere more or less with the main entrance about the end of the eastern arm.

Respectfully submitted.

S. M. MANSFIELD,
Lieut. Col., Corps of Engineers.
C. W. RAYMOND,
Major, Corps of Engineers.
W. R. LIVERMORE,
Major, Corps of Engineers.
D. W. LOCKWOOD,
Major, Corps of Engineers.
SMITH S. LEACH,
Captain, Corps of Engineers.

Brig. Gen. W. P. CRAIGHILL,
Chief of Engineers, U. S. A.

C 16.

IMPROVEMENT OF ENTRANCE TO POINT JUDITH POND, RHODE ISLAND.

Point Judith Pond is a shallow salt pond, lying in rear of the sandy beach of the Rhode Island shore, just west of Point Judith.

The improvement desired at this place by the people of the neighborhood is the reopening of an old entrance long ago closed by the ocean storms.

The present entrance to this pond is very shallow (less than 3 feet), crooked, and variable in location, and lies about a mile to the westward of the former entrance (now closed), where the improvement is desired.

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Plan of improvement.—There is at present no approved project for this work, it having been reported as not worthy of improvement in 1873 by General Warren (pp. 286–289, part 2, Annual Report of the Chief of Engineers for 1874, and House Ex. Doc. No. 84, Forty-third Congress, first session), and also in 1888 by Major Livermore (pp. 642–643, Annual Report for 1889), and also in 1893 by Captain Bixby (see pp. 841 and 879, Annual Report for 1893). The appropriation for 1894 orders that all money so far appropriated shall be used in improving the former entrance to said pond.

Amount expended and results to June 30, 1896.—The total amount expended on this work up to June 30, 1896, was $518.38, by which a survey of the locality had been made. A report of this survey, with estimate and project, was submitted July 2, 1895, and printed at page 689, Annual Report of the Chief of Engineers for 1895, and by direction of the Secretary of War further action was delayed until the subject can again be considered by Congress. No field work has yet been done except in the way of examination and survey.

Operations during the past fiscal year.—No work done and no funds expended during the past fiscal year.

Point Judith Pond is in the collection district of Newport, which is a port of entry. The amount of revenue collected at Newport in the last calendar year was $190.45. The nearest light-house is Point Judith Light. The nearest fortification is the fort on Dutch Island, Rhode Island.

Money statement.

July 1, 1896, balance unexpended	$9,481.62
July 1, 1897, balance unexpended	9,481.62

AMOUNTS APPROPRIATED.

July 13, 1892	7,500.00
August 17, 1894	2,500.00
Total	10,000.00

For the commercial statistics, see report of harbor of refuge at Point Judith, Rhode Island.

C 17.

HARBOR OF REFUGE AT BLOCK ISLAND, RHODE ISLAND.

This island is part of the State of Rhode Island; is 14 miles east of Montauk Point, the eastern end of Long Island, and is about 10 miles from the nearest point of the mainland. Besides supplying the wants of the mackerel-fishing fleet and the general coast navigation, the island is an important point on our shores for ocean navigation. It has a signal station connected by submarine telegraph with the mainland. Vessels are passing the island at all times and on all sides of it, and its position renders it of national importance. The object of the improvement is to furnish a harbor of refuge for medium-draft vessels engaged in foreign and coastwise commerce. The mean rise and fall of the tide is about 3 feet.

Original condition.—Before the construction of the present harbor of refuge Block Island had no harbor which afforded protection for decked

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vessels. The only ones used were open boats, which on the approach of storms were hauled up on the beach by oxen. The largest of these boats were of about 10 tons burden.

Plans of improvement.—Between 1870 and 1876, $285,000 was appropriated to build a breakwater for a harbor for medium-draft vessels. This work, including an inner harbor of 7 feet depth for temporary use of the Government plant, was completed in 1878. (See p. 202 of Annual Report for 1877 and p. 313 of 1879.)

In 1880, $6,000 was appropriated for dredging the inner basin to 9 feet depth. This work was completed in 1881. (See p. 390 of Annual Report for 1880 and p. 563 of 1881.)

In 1882, $19,000 was appropriated for building a sea wall on the east side of the inner basin and protecting the cliffs on east side of breakwater. (See p. 563 of Annual Report for 1882.) This work was completed in 1884.

In 1884, $15,000 was appropriated for additions to the old breakwater. (See p. 628 of Annual Report of 1884.) These additions were made in 1884–85, partially closing a gap in this old breakwater.

The project of 1884, as modified in 1888, provided for the construction of a harbor of refuge on the eastern side of the island, consisting of an enlarged inner harbor (or basin) for small vessels and an exterior harbor for large ones. The basin was to be about 800 feet square and completely inclosed except at its 100-foot-wide entrance. The exterior harbor was already formed by an old breakwater on the east and the adjacent shore on the south and west, but an old gap near the end of this breakwater was to be filled up. The project covered the construction of the stone sea walls of the enlarged inner harbor ($46,000), the repair of the old breakwater ($24,000), and a little dredging ($5,000) along the western side of the old breakwater and also inside the harbor; all at a total cost estimated in 1888 at $75,000. This project was practically completed in 1893.

The present approved project, that of 1895, based on the report of the survey ordered in the river and harbor act of August 17, 1894, provides for raising the entire breakwater to proper height, and stopping sand leaks between certain points, and dredging the main inner harbor to a depth of 10 feet, at an estimated cost of $83,985.

A plan of the works may be found at page 612, Annual Report of the Chief of Engineers for 1885, page 844 of 1893, and in House Doc. No. 83, Fifty-fourth Congress, first session; and further details at pages 609 and 613 of 1885 and page 506 of 1888.

Amount expended and results up to June 30, 1896.—The total amount expended up to June 30, 1896, was $400,575.17, by which the gap in the old breakwater had been filled up so as to make the breakwater of 1,900 feet total length; the sea walls of the inner harbor had been completed (except as to stone fender piers at the entrance); wooden fender piers had been built for present uses, the worst rocks and bowlders had been removed from the new inner harbor, and a small amount of dredging had been done at the entrance to the inner harbor, where a shoal was constantly forming.

Operations during the past fiscal year.—The amount expended during the past fiscal year was $1,249.19.

In the spring of 1897 it was found that the entrance to the inner harbor had again shoaled considerably, and under authority of Department letter of June 4, 1897, arrangements were made with Capt. T. A. Scott, of New London, Conn., to remove about 5,000 cubic yards of

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sand, at 35 cents per cubic yard. Under this agreement work was commenced on June 17, 1897, and was in progress at the close of the fiscal year. Two thousand two hundred and fifty-eight cubic yards of sand were removed from the shoal to a depth of 10 feet at low tide.

Under present conditions the entrance to the harbor shoals up each year, by reason of sand carried through the main breakwater during easterly storms. This will continue until the breakwater is made sand tight, as provided for in project of 1895; but in order to carry this work on properly and economically sufficient money should be appropriated to complete this part of the project in one season, otherwise, unless the necessary funds are provided for maintaining the channel at the entrance by dredging it out each year at a cost of about $2,500, it will close up and the inner harbor become practically useless except for boats of very light draft.

Lights have been maintained on the north sea wall during the year.

This work was in the local charge of Mr. Edward Parrish as assistant engineer, with Mr. Lester E. Dodge as inspector.

Work required to complete the existing project.—The work required to complete the existing project is to repair the main breakwater and stop sand leaks through certain portions of it, and to dredge the enlarged inner harbor to a depth of 10 feet.

Operations contemplated for the fiscal year ending June 30, 1898.—It is proposed to retain the small amount of available funds to keep the entrance to the inner harbor open until sufficient funds are available to provide for effective work in repairing the main breakwater.

Block Island is in the Newport collection district, and Newport is the nearest port of entry. The revenue collected at Newport during the last calendar year was $190.45. There is no duty collected at Block Island. The value of the harbor is mainly as a harbor of refuge. There are several lights at the island. The nearest fortification is Fort Adams, R. I.

Money statement.

July 1, 1896, balance unexpended	$5,924.83
June 30, 1897, amount expended during fiscal year	1,249.19
July 1, 1897, balance unexpended	4,675.64
July 1, 1897, outstanding liabilities	882.71
July 1, 1897, balance available	3,792.93
Amount (estimated) required for completion of existing project	78,985.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	78,985.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

AMOUNTS APPROPRIATED.

July 11, 1870	$30,000	July 5, 1884	$15,000
March 3, 1871	75,000	August 5, 1886	20,000
June 10, 1872	50,000	August 11, 1888	15,000
March 3, 1873	50,000	September 19, 1890	15,000
June 23, 1874	20,000	July 13, 1892	24,000
March 3, 1875	20,000	August 17, 1894	2,500
August 14, 1876	40,000	June 3, 1896	5,000
June 14, 1880	6,000		
August 2, 1882	19,000	Total	406,500

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COMMERCIAL STATISTICS.

The commerce arriving and leaving Block Island, Rhode Island, by water during the calendar years ending December 31, 1891–1896, is estimated as follows (based mainly upon reports received from Mr. C. C. Ball, Block Island, Rhode Island):

Class of goods.	1891.	1892.	1893.	1894.	1895.	1896.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Cotton and products			5	5		10
Tobacco	25	30	30	30	30	30
Rice	14	10	20	10	10	12
Grains and forage	612	560	800	1,050	1,130	1,250
Vegetables and truck	200	270	350	480	515	650
Live stock and products	808	740	2,000	1,100	2,100	2,500
Fish, oysters, etc	9,186	8,280	2,500	10,250	10,050	15,000
Naval stores				10	5	10
Lumber and products	5,738	5,170	5,000	4,100	7,000	6,500
Coal, minerals, and products	7,400	6,660	7,401	10,000	8 650	15,000
Fertilizers	100	90	120	130	150	200
Machinery	3	10	10			100
General merchandise	4,769	4,500	6,000	7,000	6,625	6,000
Sundries	6,837	6,300	13,000	9,000	8,870	2,500
Total	35,692	32,600	37,235	43,165	45,135	50,362

New transportation companies established during the year, none reported.

The vessels entering and leaving this waterway are as follows (each entrance and departure together being counted as one):

Character or class of service.	Number.	Average draft.	Average tonnage.
		Feet.	*Tons.*
Steam:			
Freight and passenger	700	7	500
Fishing	500	7.5	130
Tugs	300	7.5	135
Pleasure boats	1,250	7	125
Sail:			
Freight	250	9	150
Fishing boats	6,000	7	30
Oyster boats	200	6	30
Pleasure boats, large	1,000	8	15
Pleasure boats, small	6,000	5.5	6
Barges	25	10	300

C 18.

IMPROVEMENT OF GREAT SALT POND, BLOCK ISLAND, RHODE ISLAND.

The Great Salt Pond is a large pond of salt water, lying about the center of Block Island. Before the commencement of the present improvement it was separated from the ocean on the west by a comparatively narrow strip of sandy shore. The State of Rhode Island and the town of New Shoreham have appropriated altogether $115,000 toward establishing a channel from deep water in the ocean to deep water in the pond and protecting same by stone jetties.

With the funds thus appropriated the local authorities have built 837 feet of the southern jetty and carried the northern jetty out for a short distance, besides dredging a channel about 450 feet wide, with a minimum width of 150 feet, carrying at least 12 feet of water at low tide.

Plans of improvement.—The present approved project, that of 1895, provides for extending the south jetty out to the 18-foot contour and the north jetty to the 12-foot contour, also for dredging a channel having a central depth of 25 feet with a width of 150 feet, gradually shoal-

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ing to a depth of 12 feet with a width of 504 feet, thence to high-water line with a slope of 1 on 4; the total width at low water to be 600 feet. All at a total estimated cost, exclusive of the expenditures of the State and town, of $97,567.94.

At the time Lieut. Col. S. M. Mansfield, Corps of Engineers, made his report on this improvement the price per cubic yard for dredging was 10.7 cents, and his estimate for completing the work was based on these figures. Since then considerable hard clay and bowlders have been found in the dredging and the price paid per cubic yard has been 14⅞ cents, which would change the estimate for completion considerably.

The report of survey with map was published as House Doc. No. 57, Fifty-fourth Congress, first session, and the report, with map omitted, at page 620, Annual Report of the Chief of Engineers for 1896.

Operations during the past fiscal year.—No work was in progress at this place by the Government at the commencement of the fiscal year. A contract for jetty construction (at the entrance to the pond) under the 1896 appropriation was entered into on October 1, 1896, with Messrs. S. & E. S. Belden, of Hartford, Conn., at $1.33 per ton for stone in place in the jetty.

Under the provisions of the above contract, work was commenced by the contractors on October 3, 1896, suspended for the winter on December 24, 1896, resumed April 7, 1897, and was in progress at the close of the fiscal year. Twenty-five thousand seven hundred and one tons of stone were placed in the south jetty, extending the same to the 18-foot contour, 1,262 feet from shore. A small amount of work in finishing off the full section of the jetty remains to be done after the close of the fiscal year.

This work was in the local charge of Mr. Edward Parrish, as assistant engineer, with Mr. Kneeland P. Partelow as inspector.

Work required to complete the existing project.—The completion of the south jetty, the deepening and widening of the channel, and the extension of the north jetty.

Operations contemplated for the fiscal year ending June 30, 1898.—It is proposed to apply the available funds to the completion of the south jetty to its full dimensions under the existing contract.

Great Salt Pond is in the Newport collection district, and Newport is the nearest port of entry. The revenue collected at Newport during the last calendar year was $190.45. There is no duty collected at this place. The value of the harbor is mainly as a harbor of refuge. There are several light-houses at the island. The nearest fortification is Fort Adams, R. I.

Money statement.

July 1, 1896, balance unexpended		$40,000.00
June 30, 1897, amount expended during fiscal year		26,890.24
July 1, 1897, balance unexpended		13,109.76
July 1, 1897, outstanding liabilities	$8,564.45	
July 1, 1897, amount covered by uncompleted contracts	817.67	
		9,382.12
July 1, 1897, balance available		3,727.64
Amount (estimated) required for completion of existing project		57,567.94
Amount that can be profitably expended in fiscal year ending June 30, 1899		57,567.94
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

AMOUNT APPROPRIATED.

June 3, 1896	$40,000

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Abstract of proposal received and opened September 21, 1896, by Maj. D. W. Lockwood Corps of Engineers, for jetty construction at entrance to Great Salt Pond, Block Island, Rhode Island.

No.	Name and address of bidder.	Rate per ton.
1	S. & E. S. Belden, Hartford, Conn	$1.33

Contract awarded to S. & E. S. Belden.

Contract in force.

Contractor.	Date of approval.	To commence.	To complete.
S. & E. S. Belden	Oct. 12, 1896	Oct. 15, 1896	July 1, 1897

COMMERCIAL STATISTICS.

The commerce arriving and leaving the Great Salt Pond, Block Island, Rhode Island, by water during the calendar year ending December 31, 1896, is estimated as follows (based mainly upon reports received from Mr. C. E. Champlin, of Block Island, Rhode Island):

	Tons.
Grains and forage	1,600
Vegetables and truck	100
Fish, oysters, etc	2,000
Lumber and products	900
Coal, minerals, etc	250
General merchandise	250
Sundries	100
Total	5,200

New transportation lines established during the year as follows: The Montauk Steamboat Company, daily, from New York, N. Y. (two boats), during the summer, and the Block Island Steamboat Company, daily, from New London and Norwich, Conn., during the summer.

The vessels entering and leaving this waterway are as follows (each entrance and departure together being counted as one):

Character or class of service.	Number.	Average draft.	Average tonnage.
		Feet.	*Tons.*
Steam:			
Freight and passenger	560	10	500
Fishing	100	10	100
Sail:			
Fishing vessels (schooners)	3,054	11	100
Fishing boats	2,378	5	10
Pleasure boats, large	100	3	5
Barges	45	9	300

C 19.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

1. Schooner Enterprise.—This schooner was wrecked during the severe northeast gale of May 6, 1896, and sank in Vineyard Sound, about one-eighth mile east-southeast of Buoy 11 A, eastern end of Norton Shoal, with about 15 feet of water over her. By Department indorsement of May 21, 1896, her removal was authorized and $1,200 allotted therefor; the work to be done after the sixty-day limit imposed by law.

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The work of her removal by hired labor was completed on July 14, 1896; and a final inspection made on that date showed a least depth of 30 feet at low water over the remaining portions of the wreck.

The total cost of the work was $283.90, and the balance of the allotment was returned to the United States Treasury.

2. Wreck east-southeast Chatham Life Saving Station.—An unknown wreck about 3 miles east-southeast from the life saving station at Chatham, Mass., was reported March 2, 1897, and by Department letter of March 9, 1897, her removal was authorized and $500 allotted therefor. Although a thorough search was made by the wrecking force, no trace of this wreck could be found.

No funds were expended in connection with the removal of this wreck.

3. Wreck in Vineyard Sound southeast from Bishop and Clerk's Light.—An unknown wreck about 5.5 miles southeast from Bishop and Clerk's Light, was reported March 13, 1897, and by Department letter of March 17, 1897, her removal was authorized, and $500 allotted therefor. The work of removal, by hired labor, was completed on the 31st of March. A final inspection made on that date showed a least depth of about 35 feet at low water over any remaining portions of the wreck.

The total cost of this work was $164.24, and the unused funds have been covered into the United States Treasury.

C 20.

PRELIMINARY EXAMINATION FOR OBTAINING A CHANNEL THROUGH CONANICUT ISLAND, NARRAGANSETT BAY, RHODE ISLAND.

[Printed in House Doc. No. 3, Fifty-fifth Congress, first session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., March 11, 1897.

SIR: I have the honor to submit the accompanying copy of report, dated March 4, 1897, by Maj. D. W. Lockwood, Corps of Engineers, upon the results of a preliminary examination for obtaining a channel through Conanicut Island, Narragansett Bay, Rhode Island, made in compliance with the provisions of the river and harbor act of June 3, 1896.

Major Lockwood states that a channel across Conanicut Island would in no sense be of national importance; that the interests that would be affected are purely local and not at all commensurate with the expense that would be incurred in carrying out such a project, and that there are practically no commercial interests involved outside of passenger travel. For these reasons he does not deem the locality to be worthy of improvement by the United States.

The views of Major Lockwood are concurred in by the division engineer, Col. G. L. Gillespie, Corps of Engineers, and by me.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

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REPORT OF MAJ. D. W. LOCKWOOD, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Newport, R. I., March 4, 1897.

GENERAL: The river and harbor act of 1896 provided for a preliminary examination with regard to a "channel through Conanicut Island, Narragansett Bay, Rhode Island." By Department letter dated June 16, 1896, the duty of making this examination was assigned to me. In connection therewith, and after personal examination, I have the honor to submit the following report:

Conanicut Island is about 9 miles long and of about 1 mile average width. It divides the main entrance to Narragansett Bay into two channels, the eastern and western passages, respectively. Situated as it is, all communication by water between Newport and the mainland to the west of the western passage must be by a circuitous route around the north or south end of the island. The object of a channel through the island is merely to provide a short all-water route between the localities mentioned. The present route is by ferryboat from Newport to Jamestown, a transfer across the island of about a mile, then by ferryboat to the west shore. The most available locality for a channel across the island is just north of Freebody Hill through Round Swamp.

This subject was gone over very thoroughly by Maj. W. H. Bixby, Corps of Engineers, in a report made by him dated May 31, 1895, and published in the Report of the Chief of Engineers, United States Army, for 1895, page 745. Major Bixby gives in great detail the interests that would be affected by the suggested channel, etc., and I would respectfully invite attention to his report.

Briefly stated, a channel across Conanicut Island would in no sense be of national importance. The interests that would be affected are purely local, and not at all commensurate with the expense that would be incurred in carrying out such a project. There are practically no commercial interests outside of passenger travel involved.

For the above reasons, I do not deem the locality worthy of improvement.

Very respectfully, your obedient servant,

D. W. LOCKWOOD,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

(Through the Division Engineer.)

[First indorsement.]

NORTHEAST DIVISION ENGINEER OFFICE,
New York, March 5, 1897.

Respectfully forwarded to the Chief of Engineers, concurring in the views expressed by the local engineer, that the excavation of a "channel through Conanicut Island, Narragansett Bay, Rhode Island," is an improvement not worthy to be undertaken at present by the General Government.

G. L. GILLESPIE,
Colonel, Corps of Engineers, Division Engineer.

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C 21.

SURVEY OF CHANNEL IN NEW BEDFORD HARBOR, MASSACHUSETTS, LEADING TO THE BRIDGE BETWEEN THAT CITY AND FAIRHAVEN, WITH A VIEW TO DETERMINING WHAT AMOUNT OF DREDGING WOULD BE NECESSARY TO MAKE THE CHANGE IN THE DRAW IN SAID BRIDGE FROM THE WEST TO THE EAST SIDE OF FISH ISLAND PRACTICABLE AND ADVANTAGEOUS.

[Printed in House Doc. No. 146, Fifty-fourth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 29, 1896.

SIR: I have the honor to submit the accompanying copy of report of December 23, 1896, with map,* by Maj. D. W. Lockwood, Corps of Engineers, of the results of a survey of channel in New Bedford Harbor, Massachusetts, leading to the bridge between that city and Fairhaven, with a view to determining what amount of dredging would be necessary to make the change in the draw in said bridge from the west to the east side of Fish Island practicable and advantageous, made to comply with the provisions of the river and harbor act of June 3, 1896.

Major Lockwood states that, in his opinion, the channel leading to the proposed draw between Fish Island and Popes Island should be 250 feet wide and 18 feet deep at mean low water, and to excavate such a channel will require the removal of 74,000 cubic yards of material above the bridge and 118,000 cubic yards below the bridge. He estimates the cost, in round numbers, at $34,000.

In forwarding Major Lockwood's report to this office the division engineer, Col. John M. Wilson, Corps of Engineers, states that he concurs in the views of the local engineer.

Very respectfully, your obedient servant,

W. P. CRAIGHILL,
Brig. Gen., Chief of Engineers.

Hon. DANIEL S. LAMONT,
Secretary of War.

REPORT OF MAJ. D. W. LOCKWOOD, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Newport, R. I., December 23, 1896.

GENERAL: In accordance with the provisions of section 9 of the river and harbor act of June 3, 1896, and orders from your office dated July 24, 1896, I have the honor to submit the following report and estimate based upon a survey of—

channel in New Bedford Harbor, Massachusetts, leading to the bridge between that city and Fairhaven, with a view to determining what amount of dredging would be necessary to make the change in the draw in said bridge from the west to the east side of Fish Island practicable and advantageous.

For a great many years a bridge has been in existence between New Bedford and Fairhaven, crossing Fish and Popes islands. When the bridge was built there was but little commerce from or to points above, and the provisions made for passing it, while ample for that period, are

*Not reprinted. Printed in House Doc. No. 146, Fifty-fourth Congress, second session.

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now wholly inadequate, and this condition of affairs is becoming worse each year. Cotton factories are being built above the bridge, and the coal they require must pass through the draws.

The present draw openings were reported by General Warren, in 1875, as too narrow for the requirements of that date, and as the channel leading from the sea to New Bedford has been deepened and widened since then, admitting a larger class of vessels than formerly, the objections to the present draw are more pronounced now than ever before. The approaches to the draw are insufficient; below the bridge the approach is, in one place, but 125 feet wide, and this width is frequently still further contracted by vessels loading or unloading across the ends of wharves in the vicinity. It is no unusual thing during high winds for vessels to get fast in the draw, stopping traffic on the bridge. It should be stated that only the west draw opening can be used.

A new bridge is now in process of construction, to take the place of the old one; the actual construction of a part of it extending from Fairhaven to the harbor line west of Popes Island has been authorized by the Secretary of War, and in case the change in the location of the draw from its present position between New Bedford and Fish Island to some point between Fish Island and Popes Island is not made in the new structure, this obstruction to navigation will be continued.

The channel leading to the proposed draw between Fish and Popes islands should, in my opinion, be 250 feet wide and 18 feet deep at mean low water. This will require the removal of 74,000 cubic yards of material above the bridge and 118,000 cubic yards below the bridge to carry the channel to the anchorage basin, the project for which has already been adopted. The above quantities are scow measurement.

It is estimated that the excavation will cost as follows (18 cents per cubic yard above the bridge and 15 cents below):

74,000 cubic yards, at 18 cents	$13,320
118,000 cubic yards, at 15 cents	17,700
	31,020
Contingencies, engineering, etc., 10 per cent	3,102
Total	34,122

or, in round numbers, $34,000.

Very respectfully, your obedient servant,

D. W. LOCKWOOD,
Major, Corps of Engineers.

Brig. Gen. W. P. CRAIGHILL,
Chief of Engineers, U. S. A.

C 22.

SURVEY OF MOUNT HOPE BAY AND FALL RIVER HARBOR, MASSACHUSETTS.

[Printed in House Doc. No. 56, Fifty-fifth Congress, first session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., May 25, 1897.

SIR: I have the honor to submit the accompanying report of May 3, 1897, with map,* by Maj. D. W. Lockwood, Corps of Engineers, of a sur-

*Not reprinted. Printed in House Doc. No. 56, Fifty-fifth Congress, first session.

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vey of Mount Hope Bay and Fall River Harbor, Massachusetts, made to comply with the provisions of the river and harbor act of June 3, 1896.

Two plans of improvement are presented by Major Lockwood, as follows:

1. To provide a channel 25 feet deep and 300 feet wide by dredging across the flats on the southern approach from Narragansett Bay to the city and along the city front to the yacht-club dock, at an estimated cost of $175,411.94.

2. To provide a channel 25 feet deep and 300 feet wide along the city front between the Old Colony wharf and deep water at the upper end of the city front, at an estimated cost of $58,060.47. This work is included in the larger estimate mentioned above.

The improvement contemplated by the latter project is deemed by Major Lockwood to be sufficient for the present needs of commerce, but the division engineer, Col. G. L. Gillespie, Corps of Engineers, in forwarding the report to this office, states:

The within report says that "Fall River is the largest cotton-manufacturing city in the United States, and its commerce is increasing yearly. At present the maximum draft for sailing vessels is 20 feet, and advantage must be taken of the tide to enable them to reach the city front."

In a report on the preliminary survey, February 21, 1895 (Annual Report of Chief of Engineers for 1895, p. 727), it is stated that the annual commerce of the port is 3,000,000 tons, and the value of the annual imports and exports exceeds $130,000,000.

In view of these facts, showing a present large commerce and a prospective larger commerce, I am of the opinion that the channel leading from the ocean to the wharves at Fall River should have a width of 300 feet and a depth of 25 feet at mean low water, and therefore recommend for approval the more extended project presented by the local officer.

I concur in the views of the division engineer.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF MAJ. D. W. LOCKWOOD, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Newport, R. I., May 3, 1897.

GENERAL: I have the honor to forward herewith a tracing of map of survey of "Mount Hope Bay and Fall River Harbor, Massachusetts," provided for in river and harbor act of June 3, 1896.

The field work of the survey was in charge of Assistant Engineer C. M. Winchell, and occupied from October 25 to November 15, 1896.

In his report on the preliminary examination of this locality, dated February 21, 1895, Maj. W. H. Bixby, Corps of Engineers, stated as follows:

To-day it appears desirable that the upper harbor of Fall River City and the short shoal portion of the middle Mount Hope Bay Channel should be deepened sufficiently to allow vessels that can at present enter the lower portions of Mount Hope Bay to proceed farther to the deep-water anchorage ground and to the upper harbor of the city of Fall River. This means a moderate amount of dredging to 25 feet depth at both places.

By reference to the map it will be noted that at present there exists a good channel of about 21 feet depth across Mount Hope Bay, which has been made beyond a doubt by the regular Fall River steamers that run in range with the Bristol Light and Bordens Flat Light.

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The Coast Survey chart which shows the hydrography of this section would appear to indicate that the best location for a channel would be from the lower extremity of the deep water that follows down the eastern shore some distance below Fall River across the intervening flat to about midway between Mount Hope Point and Common Fence Point; but the soundings on the Coast Survey chart were taken about 1862, and many changes appear to have taken place since then. A cut in this locality would not be as apt to stand as the longer one following the present steamboat channel, because whatever tidal flow there might be through Sakonnet River would be practically across it, and the tendency would be to fill it up slowly. The longer cut would be well marked by ranges, and the large steamers of the Fall River Line by constantly running through it would tend to maintain the depth.

A considerable amount of dredging will be required in the harbor itself to obtain as much depth as exists at present in the approaches, but it is not deemed advisable to dredge out the reentrant north of the Old Colony wharf. A special examination of this locality was made April 16, 1897, by Assistant Engineer Edward Parrish, whose report is inclosed herewith. I fully concur with the conclusions reached by Mr. Parrish concerning the nonadvisability of removing the rock ledge inside and north of the red buoy.

Fall River is the largest cotton-manufacturing city in the United States, and its commerce is increasing yearly. At present the maximum draft for sailing vessels is 20 feet, and advantage must be taken of the tide to enable them to reach the city front. A large amount of coal is landed here yearly, but only about 20 or 25 per cent is brought in sailing vessels, the remainder being carried in barges drawing 15 feet or a little more. Should a deeper channel than 20 feet be provided, sailing vessels needing the increased depth would have to be towed through the cut across Mount Hope Bay.

A cut 25 feet deep and 300 feet wide on the lines marked on map would require the following:

Dredging 1,275,723 cubic yards mud, sand, and gravel, at 12½ cents	$159,465.40
Contingencies and engineering, 10 per cent	15,946.54
Total	175,411.94

A cut from about abreast of the State line would require about 100,000 cubic yards less dredging, but would not be as permanent, as already stated, and would not be used by the Fall River steamers. While it may become necessary at some future time to deepen the approaches to Fall River, the interests of commerce do not, in my opinion, require this at present, but rather that deeper water should be provided along the city wharf line, and I would recommend that a channel 300 feet wide and 25 feet deep be made as indicated between the Old Colony Wharf and the deep water at the upper end of the city front. Wharf owners then can secure ample depth by dredging a short distance when they have deepened the water along their wharves.

The cost of this I estimate as follows:

Dredging 422,258 cubic yards mud, sand, and gravel, at 12½ cents	$52,782.25
Contingencies and engineering, 10 per cent	5,278.22
Total	58,060.47

Very respectfully, your obedient servant,

D. W. LOCKWOOD,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

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REPORT OF MR. EDWARD PARRISH, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Newport, R. I., April 17, 1897.

SIR: In accordance with your instructions of the 16th instant, I made an examination on that date of the portion of Fall River Harbor lying between the Old Colony Steamboat Company's wharf and the Staples Wharf north, with a view to determining the character of the material it would be necessary to remove in the event of extending a channel 300 feet wide and 25 feet deep in front of the wharves in this vicinity.

The part of the harbor referred to forms a small bay about 1,600 feet long and 600 feet wide, protected on the south side by the Old Colony Steamboat Company's wharf and on the north by the Staples Wharf. The shore line is entirely built up with wharves.

Twenty borings were taken with a steel-pointed rod, and their positions located by ranges and a transit on shore.

The borings indicate that there is a ledge of rock extending over nearly one-half of the area examined, covered with a layer of gravel from 0.5 to 2.6 feet thick. The general surface of this rock is from 12 to 14 feet below the plane of mean low water over the shaded area on the accompanying tracing, and increases in depth both north and south of this area.

A little to the westward of the center of the bay, referred to above, a red buoy marks the southwestern extremity of the ledge. There is no route by which a channel can be carried along the wharf front inside the buoy without crossing the ledge. Any channel of the proposed dimensions passing inside of the red buoy would require the removal of at least 90,000 cubic yards of the ledge, at a probable cost of $7 per cubic yard, or $630,000 for the rock work, in addition to nearly 200,000 cubic yards of mud dredging, which would cost about 12½ cents per cubic yard, or $25,000; a total of at least $655,000 for the channel inside of the red buoy.

The cost of a channel through this ledge, the depth remaining constant, would vary approximately with the width, but were a channel of any width made through it, it would not be of great benefit to the wharf owners without the expenditure of a very large sum on their part to increase the depth at the wharves; and as there appear to be no established harbor lines in Fall River Harbor, any considerable expenditure in improving the wharf front might be more profitably made in building the wharves out over the ledge, so that they would come to within a reasonable distance of a 25-foot channel extending, in prolongation of the channel through Mount Hope Bay, from the Old Colony Steamboat Company's wharf to the Staples Wharf and thence along the city front to the deep water leading into Taunton River.

The cost of a channel 300 feet wide and 25 feet deep from the Old Colony Wharf to the Staples Wharf would be as follows: Dredging 126,250 cubic yards of mud, at 12½ cents per yard, $15,781.25.

This latter amount would replace the $655,000 in the cost of the construction of the channel along the front of Fall River.

The accompanying tracing, from the map of the survey of Mount Hope Bay and Fall River Harbor recently made, shows the position of borings taken in the examination and a table giving the character of the material.

Very respectfully,

EDWARD PARRISH, *Assistant Engineer.*

Maj. D. W. LOCKWOOD,
Corps of Engineers, U. S. A.

C 23.

SURVEY OF SAKONNET POINT, RHODE ISLAND.

[Printed in House Doc. No. 81, Fifty-fifth Congress, first session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., July 6, 1897.

SIR: I have the honor to submit the accompanying copy of report, dated June 24, 1897, with map,* by Maj. D. W. Lockwood, Corps of Engineers, upon a survey of Sakonnet Point, Rhode Island, made to comply with the provisions of the river and harbor act of June 3, 1896.

* Not reprinted. Printed in House Doc. No. 81, Fifty-fifth Congress, first session.

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Major Lockwood states that Sakonnet Point furnishes the only landing near the ocean in this locality, it being of considerable local importance, particularly in summer, and, in his opinion, a breakwater would be of great advantage to the interests involved.

The plan of improvement submitted provides for the extension, with rock and stone, of the present old work, referred to in the report, out to the rock nearly north of it, as shown on the map, and the raising of the whole structure to 8 feet above mean low water, the top width to be 15 feet. The cost is estimated at $25,000.

The views of the local officers are concurred in by the division engineer, Col. G. L. Gillespie, Corps of Engineers.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF MAJ. D. W. LOCKWOOD, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Newport, R. I., June 24, 1897.

GENERAL: In compliance with Department letter of September 5, 1896, I have the honor to submit the following report of a survey of Sakonnet Point, Rhode Island, provided for in river and harbor act of June 3, 1896:

In 1827 a survey of this locality was made by Lieutenant Anderson of the Topographical Engineers, and a project submitted providing for a breakwater about 400 feet long. This work appears to have been undertaken and about 200 feet of the breakwater built, although not exactly on the lines laid down on Lieutenant Anderson's map, its general direction being more to the east.

A preliminary examination of Sakonnet Point was made by Maj. W. R. Livermore, Corps of Engineers, in 1888, and his report may be found in the Annual Report of the Chief of Engineers, United States Army, for 1889, part 1, page 649. A second preliminary examination was made by Capt. W. H. Bixby, Corps of Engineers, in 1895, and his report may be found in the Annual Report of the Chief of Engineers, United States Army, for 1895, Part I, pages 749 and 750.

Both Major Livermore and Captain Bixby reported the locality as worthy of improvement by the General Government. Sakonnet Point furnishes the only landing near the ocean in this locality, and is of considerable local importance, particularly in summer.

A line of steamboats runs between Providence and this point throughout the year, with double service during the summer months, to accommodate the increased population of this season of the year.

The summer population is becoming greater each year, and the need of a reliable and safe landing is increasing.

During the year 1896, 26,000 passengers were carried to and from Sakonnet Point, and the steamboat company estimates its freight for that year as follows:

Passengers carried to and taken from Sakonnet Point		26,331
Coal delivered	tons	633
Grain, 43,640 bushels, about	do	1,212
Feed of all kinds, about	do	750
Fish carried away, 1,300 barrels, about	do	162
Lumber delivered	feet	365,000

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Besides the above, we have carried away large quantities of eggs and farm produce, and have landed brick, lime, cement, hardware, groceries, and merchandise of all kinds. We have quite often had to carry freight back for one or more trips, not being able to land at Sakonnet.

In my opinion, a breakwater would be of great advantage to the interests involved, and I would respectfully recommend the following:

Prolong the present old work out to the rock nearly north of it and raise the whole to 8 feet above mean low water. The width on top to be 15 feet; the sea or weather slope to be 1 on 2 and the inner slope 1 on 1. It is thought advisable that the structure should have a core, composed of comparatively small stone, while the exposed surfaces should be composed of large rock.

It is estimated that 11,000 tons of rock will be required.

Estimate of cost.

11,000 tons of riprap, at $2 per ton	$22,000
Contingencies, engineering, etc	3,000
Total	25,000

A tracing of the survey is forwarded this day in a separate package.

Sakonnet Point is in the Newport collection district. Newport is the nearest port of entry. The amount of revenue collected at Newport in the last calendar year was $190.45. The nearest light house is Sakonnet Point light. The nearest fortification is Fort Adams, R. I.

Very respectfully, your obedient servant,

D. W. LOCKWOOD,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.
(Through the Division Engineer.)

[First indorsement.]

NORTHEAST DIVISION ENGINEER OFFICE,
New York, June 30, 1897.

Respectfully forwarded to the Chief of Engineers.

The local engineer reports the locality worthy of improvement and recommends the extension of the present old breakwater northward a distance of about 200 feet and the raising of the entire work—old and new—to 8 feet above mean low water, at an estimated cost of $25,000.

In the report of the local officer on the preliminary examination (May 31, 1895, Annual Report of Chief of Engineers for 1895, p. 749) it is stated that the lower portion of the river—

forms a natural harbor of refuge several miles square against all winds except those coming directly from the Atlantic. It is useful as a refuge during storms from the east and southeast, in which case an area of at least 2 square miles is available to vessels drawing over 30 feet depth of water, which can ride in safety behind a protection offered by the headland of Sakonnet Point.

The necessity for some local protection has been evident for a long time.

The views of the local officer in the within paper are concurred in.

G. L. GILLESPIE,
Colonel, Corps of Engineers, Division Engineer.

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C 24.

SURVEY OF EASTERLY BREAKWATER TO SHORE, POINT JUDITH, AT POINT JUDITH HARBOR OF REFUGE, RHODE ISLAND.

[Printed in House Doc. No. 53, Fifty-fifth Congress, first session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., May 11, 1897.

SIR: I have the honor to submit the accompanying report of April 14, 1897, with map, by Maj. D. W. Lockwood, Corps of Engineers, of the results of a survey for easterly breakwater to shore, Point Judith, R. I., at Point Judith harbor of refuge.

The proposed easterly breakwater was intended to increase the sheltered area between the main breakwater and the shore, and its shore end was planned to be 900 feet from the beach. The present survey was made with a view to determining the cost of closing this interval, which is estimated by Major Lockwood to be, including contingencies, $187,558.80.

In transmitting this report Major Lockwood states that, in his opinion, the proposed improvement is not worthy of being undertaken by the United States, as the same is not justified by the interests of commerce involved, and this opinion is concurred in by the division engineer, Col. G. L. Gillespie, Corps of Engineers.

The closing paragraph of the report of October 23, 1896, by a Board of Engineers referred to by Major Lockwood, is as follows:

> In view of the expense involved in completing the main work and of raising a part of it (the eastern arm as seems desirable) to the height proposed, of 13 feet above mean low water, the Board is of the opinion that the construction of a detached arm off the eastern entrance as a part of the main project may safely be deferred until the completion of the main work may demonstrate the necessity or otherwise of such a structure for additional shelter. This course seems all the more desirable in view of the fact that such a structure would necessarily interfere more or less with the main entrance about the end of the eastern arm.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF MAJ. D. W. LOCKWOOD, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Newport, R. I., April 14, 1897.

GENERAL: I have the honor to submit herewith a tracing of a survey made in compliance with river and harbor act of June 3, 1896, of "easterly breakwater to shore, Point Judith, at Point Judith harbor of refuge, Rhode Island." This work was assigned to me by Department letter of July 24, 1896.

The proposed easterly breakwater was intended to increase the sheltered area between the main breakwater and the shore, and its shore end was planned to be 900 feet from the beach. The present

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survey was made with a view to determining the cost of closing this interval.

The amount of stone required for this work is estimated at 56,836 tons, in addition to the amount required to build the part already planned, to wit, 130,795 tons.

As nearly all of the extension would be in water where the seas break most of the time, it is estimated that the cost per ton of rock in place would be at least $3, making the cost of the extension as follows:

56,836 tons riprap at $3	$170,508.00
Contingencies and engineering, 10 per cent	17,050.80
Total	187,558.80

It may be stated that if the gap between the easterly breakwater and the shore be closed, the littoral currents will be interfered with and deflected, increasing at times the difficulties of entrance to the main shelter, and besides may lead to a deposition of sand along its western face.

Attention is respectfully invited to the closing paragraph of the report of a Board of Engineer Officers on the harbor of refuge at Point Judith, R. I., dated October 23, 1896.

Very respectfully, your obedient servant,

D. W. LOCKWOOD,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

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APPENDIX D.

IMPROVEMENT OF RIVERS AND HARBORS IN CONNECTICUT, OF PAWCATUCK RIVER, RHODE ISLAND AND CONNECTICUT, AND OF CONNECTICUT RIVER, MASSACHUSETTS AND CONNECTICUT.

REPORT OF MAJ. SMITH S. LEACH, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1897, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Pawcatuck River, Connecticut and Rhode Island.
2. Stonington Harbor, Connecticut.
3. Mystic River, Connecticut.
4. Thames River, Connecticut.
5. Connecticut River below Hartford, Connecticut.
6. Harbor of refuge at Duck Island Harbor, Connecticut.
7. New Haven Harbor, Connecticut.
8. Breakwaters at New Haven, Connecticut.
9. Housatonic River, Connecticut.
10. Bridgeport Harbor, Connecticut.
11. Saugatuck River and Westport Harbor, Connecticut.
12. Norwalk Harbor, Connecticut.
13. Five Mile River Harbor, Connecticut.
14. Stamford Harbor, Connecticut.
15. Harbor at Cos Cob and Mianus River, Connecticut.
16. Greenwich Harbor, Connecticut.

SURVEYS.

17. Niantic Harbor, Connecticut.
18. New Haven Harbor, Connecticut.
19. Housatonic River, Connecticut.
20. Southport Harbor, Connecticut.

HARBOR LINES.

21. Bridgeport Harbor, Connecticut.

UNITED STATES ENGINEER OFFICE,
New London, Conn., July 17, 1897.

GENERAL: I have the honor to transmit herewith annual report upon works of river and harbor improvement in my charge for the fiscal year ending June 30, 1897. Except the harbor of Stonington and Pawcatuck River, these works were transferred to me August 5, 1896, by Maj. H. M. Adams, Corps of Engineers, pursuant to Special Order 164, dated July 14, 1896.

The excepted works were transferred to me August 21, 1896, by Maj. D. W. Lockwood, Corps of Engineers, pursuant to the order cited.

Very respectfully, your obedient servant,

SMITH S. LEACH,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

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D 1.

IMPROVEMENT OF PAWCATUCK RIVER, RHODE ISLAND AND CONNECTICUT.

[This work was in the charge of Maj. D. W. Lockwood, Corps of Engineers, until August 21, 1896.]

The present approved project, that of 1895, provides for a channel of 10 feet depth at mean low water from Stonington Harbor to Westerly, with a width of 200 feet from Stonington, Conn., to Avondale, R. I., a distance of 4 miles; a width of 100 feet from Avondale to the lower wharves of Westerly, a distance of 2.75 miles, and a width of 40 feet between the upper and lower wharves of Westerly, a distance of 0.5 mile, at a total estimated cost of $200,361.60.

Under the appropriation of $15,000 in act of June 3, 1896, and in pursuance of the programme of work approved for 1896 and 1897, contracts have been entered into with Simon C. Fraser and the Hartford Dredging Company, the lowest bidders, for the removal of about 400 cubic yards of rock and bowlders, and for dredging 30,000 cubic yards, respectively. Mr. Fraser began work April 1, 1897, and at the close of the fiscal year had taken out 266 cubic yards of rock and bowlders. His contract expires September 1, 1897.

No work was done by the Hartford Dredging Company during the fiscal year. Their contract expires on the same date as the other.

Pawcatuck River is in the collection districts of Providence and Stonington, the dividing line passing through the river. Providence and Stonington are the nearest ports of entry. The revenue collected in the last calendar year was: Providence, $272,827.41; Stonington, $34.02. The nearest light-houses are the Stonington and Watch Hill lights. The nearest fortification is Fort Trumbull, New London, Conn.

Money statement.

July 1, 1896, balance unexpended		$15,000.00
June 30, 1897, amount expended during fiscal year		1,970.95
July 1, 1897, balance unexpended		13,029.05
July 1, 1897, outstanding liabilities	$2,227.75	
July 1, 1897, amount covered by uncompleted contracts	8,173.00	
		10,400.75
July 1, 1897, balance available		2,628.30
Amount (estimated) required for completion of existing project		185,361.60
Amount that can be profitably expended in fiscal year ending June 30, 1899		25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

AMOUNTS APPROPRIATED.

March 3, 1871	$10,000.00	September 19, 1890	$16,600.00
June 10, 1872	10,000.00	July 13, 1892	3,800.00
March 3, 1873	10,000.00	August 17, 1894	6,000.00
June 23, 1874	10,000.00	June 3, 1896	15,000.00
March 3, 1875	10,000.00		
August 5, 1886	12,000.00	Total	113,400.00
August 11, 1888	10,000.00		
December 5, 1895, unexpended balance deposited to credit of the United States Treasurer			399.99
Total			113,000.01

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Abstract of proposals for dredging in Pawcatuck River, Rhode Island and Connecticut, opened by Maj. Smith S. Leach, Corps of Engineers, February 26, 1897.

[30,000 cubic yards.]

No.	Name and address of bidder.	Price per cubic yard.	Total.
		Cents.	
1	Thomas A. Scott, New London, Conn	27	$8,100.00
*a*2	Hartford Dredging Co., Hartford, Conn	23	6,900.00
3	James S. Rogers, Plattsburg, N. Y		
4	Simon C. Fraser, New London, Conn	35	10,500.00
5	John P. Randerson, Albany, N. Y	32	9,600.00
6	Frank Pidgeon, Saugerties, N. Y	63	18,900.00
7	Alonzo E. Smith, Islip, N. Y	39.9	11,970.00

a Accepted.

Abstract of proposals for removal of rock from Pawcatuck River, Rhode Island and Connecticut, opened by Maj. Smith S. Leach, Corps of Engineers, February 26, 1897.

[Removal 400 cubic yards or 800 gross tons.]

No.	Name and address of bidder.	Price per cubic yard or ton.	Total.
1	Thomas A. Scott, New London, Conn.....per ton..	$6.00	$4,800.00
2	Hartford Dredging Co., Hartford, Conn.....do....	6.25	5,000.00
3	James S. Rogers, Plattsburg, N. Y.....per cubic yard..	9.80	3,920.00
*a*4	Simon C. Fraser, New London, Conn.....do....	9.50	3,800.00
5	John P. Randerson, Albany, N. Y.....per ton..	21.00	16,800.00
6	Frank Pidgeon, Saugerties, N. Y.....per cubic yard..	11.00	4,400.00
7	Alonzo E. Smith, Islip, N. Y.....per ton..	6.00	4,800.00

a Accepted.

Contract in force June 30, 1897, for dredging in Pawcatuck River, Rhode Island and Connecticut.

Name of contractor.	Date of contract.	Date of approval.	Work begun.	Contract expires.
Hartford Dredging Co	Mar. 15, 1897	Apr. 16, 1897	.....	Sept. 1, 1897

Contract in force June 30, 1897, for removal of rock from Pawcatuck River, Rhode Island and Connecticut.

Name of contractor.	Date of contract.	Date of approval.	Work begun.	Contract expires.
Simon C. Fraser	Mar. 12, 1897	Mar. 24, 1897	Apr. 15, 1897	Sept. 1, 1897

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

The commerce arriving and leaving Pawcatuck River, Rhode Island, by water during the calendar year ending December 31, 1896, is estimated as follows (based mainly upon reports received from Messrs. Maxson & Co., Westerly, R. I.):

Class of goods.	Tons.
Grains and forage	1,220
Fish, oysters, etc	122
Lumber and products	10,813
Coal, minerals, and products	22,688
Fertilizers	40
Sundries	4,203
Total	39,086

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The vessels entering and leaving this waterway are as follows (each entrance and departure together being counted as one):

Character or class of service.	Number.	Average draft.	Average tonnage.
		Feet.	*Tons.*
Steam:			
Freight, mainly	2	7½	290
Passenger, mainly	78	5	61
Tugs	525	6	45
Sail:			
Freight	204	7.4	172
Fishing boats	2,000	2½	9
Pleasure boats, large	1,300	2½	8
Pleasure boats, small	900	1	3
Total	5,009		498

The above figures show a decrease in tonnage of freights of 4,585 tons below the amounts reported for 1895. This decrease is said to be due to the depression of the times.

Twenty-eight vessels with cargoes for Westerly were obliged to discharge at Stonington owing to lack of water in the river.

No new transportation companies have been established during the year.

D 2.

HARBOR OF REFUGE AT STONINGTON, CONNECTICUT.

[This work was in the charge of Maj. D. W. Lockwood, Corps of Engineers, until August 21, 1896.]

The present project, that of 1880, provides for an eastern breakwater as a protection to the outer harbor; this breakwater, about one-half mile long, to extend from the vicinity of Bartletts Reef to the vicinity of Middle Ground Shoal, or until sufficient protection against southerly winds shall be obtained. The estimated cost was from $143,000 to 191,000, according to length. This did not include foundation for light-house at end of finished jetty.

A plan of work may be found at page 598, Annual Report of the Chief of Engineers for 1882; page 632 of 1884; page 848 of 1893, and further information on page 585 of 1881. The position of the ends of this breakwater have not been definitely determined.

During the fiscal year no work was done on this project. The appropriation in the act of 1896, $5,000, was expended in accordance with the terms of the act in constructing a sea wall around Stonington Point. A contract was entered into with Dennis Toomey, the lowest bidder, for building the wall at $4.30 per cubic yard, measured in place.

Work was begun April 10, 1897, and finished June 5, 1897, the aggregate amount of work being 540 cubic yards. The wall has a trace of two tangents 163 and 120 feet long, making an angle of 43° with each other, and joined by a circular arc of 137° with a radius of 40 feet, making its total length 385¼ feet. The wall follows generally the line of ordinary high water. It is built in a trench 2 feet deep; has an average height of 8 feet, and consists of beach bowlders placed as dry rubble, and surmounted by a coping of heavy split granite blocks.

Stonington Harbor is in the Stonington collection district and is a port of entry. The amount of revenue collected at Stonington in the last calendar year was $34.02. The principal value of the harbor is as a harbor of refuge. The nearest lights are Stonington Light and Latimer Reef Light. The nearest fortification is Fort Trumbull, New London Harbor, Connecticut.

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Money statement.

July 1, 1896, balance unexpended	$5,845.93
June 30, 1897, amount expended during fiscal year	3,352.77
July 1, 1897, balance unexpended	2,493.16

AMOUNTS APPROPRIATED.

March 2, 1827 (survey)	$200.00	August 2, 1882	$25,000.00
May 23, 1828	20,000.00	July 5, 1884	10,000.00
April 23, 1830	16,491.67	August 5, 1886	20,000.00
June 27, 1834	262.16	August 11, 1888	8,000.00
March 3, 1873	25,000.00	September 19, 1890	12,500.00
June 23, 1874	20,000.00	July 13, 1892	12,500.00
March 3, 1875	25,000.00	August 17, 1894	5,000.00
June 18, 1878	40,000.00	June 3, 1896	5,000.00
March 3, 1879	37,500.00		
July 14, 1880	25,000.00	Total	337,453.83
March 3, 1881	30,000.00		

Abstract of proposals for building sea wall at Stonington Point, Conn., opened by Maj. Smith S. Leach, Corps of Engineers, February 26, 1897.

[Estimated yardage, 780 cubic yards.]

No.	Name and address of bidder.	Price per cubic yard.	Total.
1	D. Toomey, Guilford, Conn. *a*	$4.30	$3,354.00
2	Charles Smedley, New York, N. Y	5.73	4,469.40
3	David V. Howell, Monroe, N. Y	5.78	4,508.40
4	Isaac T. Brown, New York, N. Y	6.45	5,031.00
5	Frank Pidgeon, Saugerties, N. Y	5.89	4,594.20
6	Atwood W. Brayton, Stonington, Conn	6.00	4,680.00
7	Charles F. Stall, New London, Conn	6.15	4,797.00

a Accepted and completed.

No contracts for building sea wall at Stonington Point, Conn., in force June 30, 1897

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

The commerce arriving at and leaving Stonington Harbor, Connecticut, is estimated as follows (based mainly upon reports received from Mr. C. B. Crandall, collector of customs, Stonington, Conn., and others):

Class of goods.	Tons.
Grains and forage	1,200
Fish, oysters, etc	275
Lumber and products	10,000
Coal, minerals, and products	78,000
Fertilizers	175
General merchandise	240,000
Sundries	20,000
Total	349,650

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The vessels entering and leaving this water way are as follows (each entrance and departure together being counted as one):

Character or class of service.	Number.	Average draft.	Average tonnage.
		Feet.	*Tons.*
Steam:			
Freight and passenger	450	12	1,500
Freight mainly	65	10	1,000
Passenger mainly	800	7	35
Fishing	75	7	35
Tugs	175	8	50
Sail:			
Freight	1,000	9	120
Fishing boats	500	6	20
Pleasure boats, small	1,200	2½	7
Total	4,265	61½	2,767

No new transportation companies have been established during the year.

The above figures show an increase of 26,836 in tonnage over the report of 1895, which was 322,814 tons.

D 3.

IMPROVEMENT OF MYSTIC RIVER, CONNECTICUT.

[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until August 5, 1869.]

The present project of this improvement, adopted in 1890, contemplates a channel 15 feet deep at mean low water and 100 feet wide for a length of about 4 miles and the reduction of the curvature of four short bends. The improvement is to be effected by dredging and a removal of a small quantity of rock.

During the fiscal year no actual work was done. Under the appropriation of $3,500 in act of June 3, 1896, proposals were invited and a contract, dated January 14, 1897, entered into with the lowest bidder, Mr. J. P. Randerson, for dredging 20,000 yards at 10⅞ cents per cubic yard. The contract expires December 31, 1897. At the close of the fiscal year the contractor had not begun operations. The material will be removed from the lower bends.

Mystic River is in the New London collection district, of which New London is the port of entry. The nearest work of defense is Fort Griswold, New London Harbor, about 6 miles west. There is a light-house on Morgan Point, on the west side of the river at its mouth.

Money statement.

July 1, 1896, balance unexpended	$3,671.99
June 30, 1897, amount expended during fiscal year	403.78
July 1, 1897, balance unexpended	3,268.21
July 1, 1897, amount covered by uncompleted contracts	2,175.00
July 1, 1897, balance available	1,093.21
Amount (estimated) required for completion of existing project	3,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	3,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

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Appropriations for the improvement of Mystic River, Connecticut, have been made as follows:

Application.	Date.	Amount.
Dredging above and just below railroad bridge and at the mouth of the river.	Sept. 19, 1890	$10,000
Dredging below the railroad bridge	July 13, 1892	10,000
Dredging opposite Noank	Aug. 17, 1894	3,500
Not yet expended	June 3, 1896	3,500
Total		27,000

Abstract of proposals for dredging in Mystic River, Connecticut, opened by Capt. Smith S. Leach, Corps of Engineers, December 23, 1896.

[Estimated yardage, 20,000 cubic yards.]

No.	Name and address of bidder.	Price per cubic yard.	Total.
		Cents.	
1*a*	John P. Randerson, Albany, N. Y.	10⅞	$2,175.00
2	Newburg Dredging Co., Newburg, N. Y.	14	2,800.00
3	Wm. H. Taylor, jr., Jersey City, N. J.	11 9/10	2,360.00
4	Simon C. Fraser, New London, Conn.	13½	2,700.00
5	T. A. Scott, New London, Conn.	13	2,600.00
6	Hartford Dredging Co., Hartford, Conn.	11½	2,300.00
7	Columbian Dredging Co., Fall River, Mass.	13 7/10	2,740.00

a Accepted.

Contract in force June 30, 1897, for dredging in Mystic River, Connecticut.

Name of contractor.	Date of contract.	Date of approval.	Work begun.	Contract expires.
John P. Randerson	Jan. 14, 1897	Feb. 3, 1897	No date	Dec. 31, 1897.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

Arrival and departure of vessels.

AT MYSTIC.

[Draft 5 to 16 feet; tonnage 100 to 600 tons.]

Kind of vessel.	Number of round trips.	Aggregate tonnage of all trips.
Sailing vessels	68	41,758
Steamers, excursion steamers, and tugboats	260	9,200
Barges, scows, etc	16	8,600
Total	344	59,558

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Coal	7,200	$36,000
Lumber (5,587,000 feet)	8,380	111,740
Iron	300	9,000
Silex	2,000	80,000
Miscellaneous	8,000	150,000
Total	25,880	386,740

The above figures show an increase of tonnage since the last record received (for 1895) of 2,830 tons.

No new lines of transportation have been established during the year.

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AT NOANK, MOUTH OF RIVER.

[Through courtesy of Robert Palmer & Son.]

20 new vessels built and launched, combined tonnage	11,181.94
41 vessels repaired (10 steamers, 31 sailing)	23,970.00
150 tugboats arrived and departed	6,000.00
4,750,000 feet of lumber received	5,351.00
Total	46,502.94

These figures (46,502.94 tons) include those only that have had business at the shipyard. Other small vessels have been here of which no record has been made

D 4.

IMPROVEMENT OF THAMES RIVER, CONNECTICUT.

[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until August 5, 1896.]

The present project for improving Thames River is that of 1866, with subsequent modifications, and consists in making and maintaining by dredging and a system of training walls a channel 200 feet wide from New London to Norwich, to be 16 feet deep at mean low water up to Allyn Point (about 5 miles below Norwich), and thence to Norwich to be 14 feet deep, together with dredging in Shaws Cove, New London Harbor, to make and maintain a channel 100 feet wide and 12 feet deep and an anchorage basin of the same depth and of about 7½ acres area. The estimated cost from the beginning, in 1866, is $457,600.

At the beginning of the year a contract for dredging was in force with J. H. Fenner, for about 40,000 cubic yards of excavation in the river near Norwich, at 16 cents per cubic yard; contract dated April 17, 1895; approved by the Chief of Engineers May 2, 1895; expiring December 31, 1895. Work under the contract was about to begin in October, 1895, when the contractor's dredge was sunk while en route to the work. With approval of the Chief of Engineers the contract was extended to July 1, 1896, and subsequently to September 1, 1896.

Dredging was in progress at the beginning of the fiscal year and completed on August 10, 1896, 32,797 yards having been removed during the fiscal year, making the total amount dredged under the contract 42,711 cubic yards. At the close of work the 14-foot channel of reduced width had nearly reached the lower end of the New York and New England Railroad dock at Norwich.

Under the appropriation in act of June 3, 1896, and in pursuance of the programme approved for its expenditure, a contract has been entered into with the Newburg Dredging Company, the lowest bidders, for dredging 60,000 yards of material from the channel at 14 cents per yard. The work will be directed, so far as necessary, to restoring the project dimensions, and the balance to carrying the channel farther up at the head.

The Thames River is in the collection district of New London. The nearest lighthouse is at the mouth of the river, on the west shore. Forts Trumbull and Griswold overlook the mouth of the river from either shore.

Money statement.

July 1, 1896, balance unexpended	$21,046.00
June 30, 1897, amount expended during fiscal year	9,021.34
July 1, 1897, balance unexpended	12,024.66
July 1, 1897, amount covered by uncompleted contracts	8,400.00
July 1, 1897, balance available	3,624.66
Amount (estimated) required for completion of existing project	69,100.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	40,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

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Appropriations for improving Thames River, Connecticut, have been made as follows:

Application.	Date.	Amount.
For previous projects:		
Removal of obstructions placed during the war of 1812	Mar. 3, 1821	$150
Survey	Mar. 2, 1829	150
Piers and dredging	July 4, 1836	10,000
Do	July 7, 1838	10,000
Do	Mar. 3, 1837	20,000
Total		40,300
For the present project:		
Dredging and survey	June 23, 1866	10,000
Dredging	Mar. 3, 1867	72,000
Do	Mar. 3, 1871	15,000
Do	June 10, 1872	10,000
Do	June 18, 1878	10,000
Do	Mar. 3, 1879	12,000
Do	June 14, 1880	22,500
Dredging and training walls	Mar. 3, 1881	30,000
Training walls	Aug. 2, 1882	35,000
Do	July 5, 1884	25,000
Training walls and dredging	Aug. 5, 1886	22,500
Repairs of training walls and dredging	Aug. 11, 1888	50,000
Dredging	Sept. 19, 1890	20,000
Do	July 13, 1892	30,000
Do	Aug. 17, 1894	12,500
Not yet expended	June 3, 1896	12,000
Total		388,500
Total amount appropriated since 1821		428,800

Abstract of proposals for dredging in the Thames River, Connecticut, opened by Capt. Smith S. Leach, Corps of Engineers, December 23, 1896.

[Estimated yardage, 60,000 cubic yards.]

No.	Name and address of bidder.	Price per cubic yard.	Total.
		Cents.	
1	John P. Randerson, Albany, N. Y.	14½	$8,550
2	Newburg Dredging Co., Newburg, N. Y.	14	*a* 8,400
3	Emory R. Seward, Albany, N. Y.	23½	14,100
4	Elijah Brainard, New York, N. Y.	15⅗	9,540
5	Hartford Dredging Co., Hartford, Conn	16½	9,900
6	R. G. & J. F. Packard, New York, N. Y.	23½	14,100

a Accepted.

Contract in force June 30, 1897, for dredging in Thames River, Connecticut.

Name of contractor.	Date of contract.	Date of approval.	Work begun.	Contract expires.
Newburg Dredging Co	Jan. 11, 1897	Feb. 10, 1897		Dec. 31, 1897

COMMERCIAL STATISTICS FOR CALENDAR YEAR 1896.

Arrivals and departures of vessels.

AT SHAWS COVE, NEW LONDON HARBOR.

[Draft, 6 to 14 feet; tonnage, 10 to 300 tons.]

Kind of vessel.	Number of round trips.	Aggregate tonnage of all trips.
Steamers (tugboats)	62	
Sailing vessels	53	10,200
Barges, scows, etc	82	8,900
Total	197	19,100

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The above does not include 21 schooners and sloops, and 13 steamers laid up for the winter.

Kind of freight.	Tons.	Value.
Coal, lumber, brick, etc.	7,200	$47,000

THAMES RIVER AT ALLYN POINT AND NORWICH.

[Draft, 5 to 19 feet; tonnage, 100 to 1,900 tons.]

Kind of vessel.	Number of round trips.	Aggregate tonnage of all trips.
Sailing vessels	145	63,500
Steamers, excursion boats, and tugboats	1,102	15,000
Barges, scows, etc.	400	327,345
Total	1,647	405,845

Freight received and shipped by water.

Chief articles.	Tons.
Coal	353,770
Lumber	18,000
Miscellaneous	34,075
Total	405,845

The above record does not include the commerce of New London Harbor, which is reported as 786,341 tons, and outside of Shaws Cove can not be said to be directly benefited by the improvement.

In 1893, 546,900 tons was reported, which shows a decrease of 141,055 tons for 1896.

No new lines of transportation are reported.

D 5.

IMPROVEMENT OF THE CONNECTICUT RIVER BELOW HARTFORD, CONNECTICUT.

[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until August 5, 1896.]

The approved project for improving Connecticut River includes the construction of converging jetties at the mouth, and dredging to open and maintain a channel between them, and the maintenance of channels 9 feet deep at extreme low water across the bars below Hartford.

Appropriations of late years have been $20,000, the amount required for two years' dredging, and no progress has been made on the permanent works, nor has the jetty channel been fully developed. This channel, now about 130 feet wide and 12 feet deep, should be widened, though possibly not to the projected width of 400 feet.

The jetties were never completed, and the deterioration by settlement and wave attack has reduced them to a condition urgently requiring

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attention. At least 5,000 tons of stone should be placed on them at once.

At the beginning of the fiscal year the annual dredging was in progress under a contract with J. P. Randerson. The contract was completed August 22, 1896, and the channel left in a satisfactory condition. The amounts of material removed under this contract from the several bars during the fiscal year were as follows:

Locality.	Date.	Cubic yards.
Pistol Point Bar	July 1–9	6,837
Dividend Bar	July 10–16	7,694
Glastonbury Bar	July 16–22	4,068
Press Barn Bar	July 23–27	4,967
Calves Island Bar	July 27–Aug. 3	5,569
Potash Channel	Aug. 3–22	22,919
Total		52,054

The total amount dredged under this contract was 92,714 cubic yards, and under the terms of the contract the contractor was also paid for transferring his plant from one bar to another, nineteen and one-fourth hours at $8 per hour; and for dredging 3,320 cubic yards of stiff clay at 50 per cent greater than the contract price of 9⅞ cents, and also for board of inspector, thirteen weeks at $4.50 per week.

On February 26, 1897, bids were opened for work after the freshet of this year and a contract entered into with the Hartford Dredging Company, the lowest bidders, for removing about 100,000 cubic yards of material at 9 cents per cubic yard. The contractor put a machine on the work June 9, 1897, but a freshet reaching 20 feet on the Hartford gauge necessitated an immediate suspension. Dredging was resumed June 16 and continued to the close of the fiscal year, when 21,316 cubic yards had been removed, of which 21,038 cubic yards was removed from Hartford Bar, and the remainder, 278 yards, from Clay Banks Bar.

The Connecticut River is in the collection district of Hartford. There is a lighthouse on Saybrook Point, on the west shore of the river at its mouth, and another at the end of the west jetty, besides which there are three small beacon lights and several range lights in the river which are maintained by the United States. Fort Trumbull, New London Harbor, Conn., about 16 miles east of Saybrook Point, is the nearest work of defense.

Money statement.

July 1, 1896, balance unexpended		$32,407.07
June 30, 1897, amount expended during fiscal year		12,482.68
July 1, 1897, balance unexpended		19,924.39
July 1, 1897, outstanding liabilities	$1,921.54	
July 1, 1897, amount covered by uncompleted contracts	7,081.56	
		9,003.10
July 1, 1897, balance available		10,921.29
Amount (estimated) required for completion of existing project		130,000.00
Amount (estimated) required for maintenance annually		10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

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Appropriations for improving the Connecticut River below Hartford have been made as follows:

Application.	Date.	Amount.
Dredging at Saybrook Bar	July 4, 1836	$20,000.00
Dredging at Saybrook Bar (the unexpended balance of 1836 reappropriated.)	Mar. 3, 1839	
Balance due contractor under previous appropriation	Mar. 1, 1843	3,471.57
Dredging at Pratts Ferry, Pistol Point, Mouse Island; piling at Hartford	July 11, 1870	20,000.00
Dredging at Hartford, Clay Banks, Pier I, Pier J, Pratts Ferry, Glastonbury, Pistol Point, and Chester Rock	Mar. 3, 1871	35,000.00
Dredging at Pratts Ferry, Pistol Point, and Saybrook jetty	June 10, 1872	40,000.00
Dredging at Hartford, Pratts Ferry, Glastonbury, and Saybrook jetty	Mar. 3, 1873	20,000.00
Dredging at Hartford, Pratts Ferry, Saybrook, Saybrook jetties	June 23, 1874	20,000.00
Dredging at Hartford, Pratts Ferry, Glastonbury, Saybrook jetties	Mar. 3, 1875	20,000.00
Dredging at Hartford, Pratts Ferry, Glastonbury, Saybrook jetties, Salmon River dredging	Aug. 14, 1876	20,000.00
Compensation for previous dredging	—— 1878	4,203.00
Saybrook jetties, survey from Hartford to Rocky Hill	June 18, 1878	30,000.00
Dredging at Hartford, Press Barn, Glastonbury	Mar. 3, 1879	10,000.00
Dredging at Hartford, Glastonbury, and Saybrook jetties	June 14, 1880	10,000.00
Dredging at Hartford, Pratts Ferry, Glastonbury, Glastonbury wing dam, Saybrook jetties	Mar. 3, 1881	30,000.00
Dredging at Hartford, Clay Banks, Pratts Ferry, Press Barn, Glastonbury, Dividend, Pistol Point, and Salmon River, Hartford dike	Aug. 2, 1882	45,000.00
Dredging at Hartford, Clay Banks, Pratts Ferry, Press Barn, Glastonbury, Dividend, Pistol Point, Mouse Island, and between Saybrook jetties, extending west jetty at Saybrook	July 5, 1884	35,000.00
Compensation for previous dredging	Mar. 3, 1885	4,745.43
Dredging at Hartford, Clay Banks, Naubuc, Press Barn, Glastonbury, Dividend, Pistol Point, and Haddam Island; repairs of Hartford dike and Saybrook jetties	Aug. 5, 1886	26,350.00
Annual dredging at Hartford, Clay Banks, Press Barn, Glastonbury, Dividend, Brookways	Aug. 12, 1888	10,000.00
Annual dredging at Hartford, Clay Banks, Press Barn, Glastonbury, Dividend, Pistol Point, Mouse Island, Haddam Island	Sept. 19, 1890	12,500.00
Annual dredging at Hartford, Clay Banks, Naubuc, Press Barn, Glastonbury, Dividend, Pistol Point, Mouse Island, Sears Shoal, Chester Rock, Devils Reef, Calves Island	July 13, 1892	20,000.00
Annual dredging upon several bars below Hartford, in progress	Aug. 17, 1894	20,000.00
Not yet expended	June 3, 1896	20,000.00
Total		476,170.00

Abstract of proposals for dredging in Connecticut River, Connecticut, opened by Maj. Smith S. Leach, Corps of Engineers, February 26, 1897.

[Estimated yardage, 100,000 cubic yards.]

No.	Name and address of bidder.	Price per cubic yard.	Total.
		Cents.	
1	Alonzo E. Smith, Islip, N. Y.	12½	$12,500.00
2	John P. Randerson, Albany, N. Y.	10¼	10,250.00
3	Frank Pidgeon, Saugerties, N. Y.	13 3/10	13,900.00
4	Hartford Dredging Co., Hartford, Conn.	9	*a* 9,000.00
5	Newburg Dredging Co., Newburg, N. Y.	9½	9,500.00

a Accepted.

Contract in force June 30, 1897, for dredging in Connecticut River, Connecticut.

Name of contractor.	Date of contract.	Date of approval.	Work begun.	Contract expires.
Hartford Dredging Co	Mar. 15, 1897	Apr. 16, 1897	June 9, 1897	

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COMMERCIAL STATISTICS FOR CALENDAR YEAR 1896.

[Through courtesy of Mr. C. C. Goodrich, general manager of the Hartford and New York Transportation Company.]

Arrivals and departures of vessels.

[Draft, 7 to 10 feet; tonnage, 100 to 1,600 tons.]

Kind of vessel.	Number of round trips.	Aggregate tonnage of all trips.
Steamers	390	775,000
Sailing vessels	230	
Barges	680	
Total	1,300	775,000

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Receipts:		
Coal	325,000	$30,000,000
Stone	50,000	
Miscellaneous goods	175,000	
Shipments:		
Stone	90,000	10,300,000
Wood, lumber, etc	50,000	
Miscellaneous goods	82,000	
Total receipts and shipments	772,000	40,300,000

These figures show an increase in tonnage of freights of 60,000 tons over that reported for 1895.

No new lines of transportation have been established during the year. The above freights are a close estimate from the Hartford and New York Company's books, they doing practically three-fourths of all the freighting.

D 6.

IMPROVEMENT OF HARBOR OF REFUGE AT DUCK ISLAND, CONNECTICUT.

[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until August 5, 1896.]

The project for this improvement consists in building three breakwaters, aggregating 5,880 feet in length. At the beginning of the fiscal year 2,385 feet had been built. No work was done during the fiscal year.

A contract has been entered into with J. Frank Quinn, the lowest bidder, for placing 25,000 tons of riprap in the structure, at 65 cents per ton. The contract expires August 27, 1897.

The execution of this contract will complete 3,000 linear feet of the breakwaters of 5,880 projected, but with a smaller cross section than projected.

Duck Island is in the collection district of Hartford. The nearest light-house is at Saybrook Point, at the mouth of the Connecticut River, about 8 miles eastward. There is a light vessel on Long Sand Shoal, about 5 miles to the southeast. Fort Trumbull, New London Harbor, 21 miles east, is the nearest work of defense.

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Money statement.

July 1, 1896, balance unexpended		$31,784.84
June 30, 1897, amount expended during fiscal year		9,458.29
July 1, 1897, balance unexpended		22,326.55
July 1, 1897, outstanding liabilities	$69.15	
July 1, 1897, amount covered by uncompleted contracts	16,250.00	
		16,319.15
July 1, 1897, balance available		6,007.40
Amount (estimated) required for completion of existing project		349,540.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

Appropriations for harbor of refuge at Duck Island Harbor, Connecticut, have been made as follows:

Application.	Date.	Amount.
Westerly breakwater:		
946 feet	Sept. 19, 1890	$25,000
714 feet	July 13, 1892	35,000
725 feet and repairs	Aug. 17, 1894	30,000
Not yet expended	June 3, 1896	24,000
Total		114,000

Abstract of proposals for constructing breakwater at Duck Island, Connecticut, opened by Capt. Smith S. Leach, Corps of Engineers, October 28, 1896.

[Estimated tonnage, 25,000 tons.]

No.	Name and address of bidder.	Price per gross ton.	Total.
1	S. & E. S. Belden, Hartford, Conn	$0.93	$23,250.00
2	J. Frank Quinn, New York, N. Y	.65	a 16,250.00
3	John J. Shipman, Washington, D. C	1.40	35,000.00

a Accepted.

Contract in force June 30, 1897, for constructing breakwater at Duck Island, Connecticut.

Name of contractor.	Date of contract.	Date of approval.	Work begun.	Contract expires.
J. Frank Quinn	Nov. 20, 1896	Dec. 5, 1896		Aug. 25, 1897

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

No record of the number of vessels passing this harbor of refuge is kept. It is believed to be approximately two-thirds of the number passing the New Haven Breakwater, which is reported as 151,356 for the year 1895.

During the twelve months up to July 1, 1897, a record has been kept of the number of vessels observed at anchor behind the Duck Island Breakwater, which is as follows:

Schooners	124	Barges and canal boats	24
Sloops	6	Steamers	4
Yachts	15	Pile driver	1
Towboats	8		
Fleet of barges in tow	1	Total	188
Steam barges	5		

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D 7.

IMPROVEMENT OF NEW HAVEN HARBOR, CONNECTICUT.

[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until August 5, 1896.]

The present project for this work, now approaching completion, provides for a dredged channel 16 feet deep at mean low water, 400 feet wide from the Sound across Fort Hale Bar, a distance of 1¼ miles, and 400 to 700 feet wide from the upper side of the bar to the head of the harbor, 2 miles.

A dike has also been built to aid in the development of the channel across the bar. This project now lacks to complete it only the widening of the Fort Hale cut from 100 to 400 feet.

A contract was entered into January 7, 1897, with William H. Taylor, jr., the lowest bidder, for dredging 90,000 cubic yards in the Fort Hale channel at 8 cents per cubic yard, work to be completed by December 31, 1897. This will widen the channel to about 200 feet.

In pursuance of a requirement in the act of June 3, 1896, a resurvey was made during the last fiscal year, and its results, with the revised project called for, are reported elsewhere.

New Haven, the port of entry for the collection district of New Haven, is situated at the head of New Haven Harbor, about 3½ miles from Long Island Sound. There is a light-house on Southwest Ledge, at the mouth of the harbor. Fort Trumbull, New London Harbor, 43 miles east, is the nearest work of defense.

Money statement.

July 1, 1896, balance unexpended		$10,988.64
June 30, 1897, amount expended during fiscal year		1,761.78
July 1, 1897, balance unexpended		9,226.86
July 1, 1897, outstanding liabilities	$2.50	
July 1, 1897, amount covered by uncompleted contracts	7,200.00	
		7,202.50
July 1, 1897, balance available		2,024.36
Amount (estimated) required for completion of existing project		28,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		28,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

Appropriations for the improvement of New Haven Harbor have been made as follows:

Application.	Date.	Amount.
Removal of Middle Rock, not expended until 1867	Aug. 30, 1852	$6,000
Removal of rocks	July 11, 1870	15,000
Dredging (13 feet) above Fort Hale	Mar. 3, 1871	40,000
Dredging (16 feet) Fort Hale Bar, and removal of rocks	June 10, 1872	35,000
Dredging (16 feet) Fort Hale Bar	Mar 3, 1873	25,000
Dredging (13 feet) above Long wharf	Mar. 3, 1875	10,000
Dredging (16 feet) Long wharf to Fort Hale	June 18, 1878	25,000
Dredging (16 feet) above Long wharf	Mar. 3, 1879	15,000
Do	June 14, 1880	15,000
Dredging (16 feet) Long wharf to Fort Hale	Mar. 3, 1881	15,000
Sandy Point Dike	Aug. 2, 1882	30,000
Dredging (18, 12, and 8 feet) above Long wharf	July 5, 1884	10,000
Sandy Point Dike	Aug. 5, 1886	20,000
Do	Aug. 11, 1888	15,000
Dredging	Sept. 19, 1890	15,000
Do	July 13, 1892	15,000
Dredging (Fort Hale Bar)	Aug. 17, 1894	10,000
Resurvey and dredging	June 3, 1896	10,000
Total		326,000

The first appropriation, $6,000, was applied to a previous project.

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Abstract of proposals for dredging in New Haven Harbor, Connecticut, opened by Capt. Smith S. Leach, Corps of Engineers, December 23, 1896.

[Estimated yardage 90,000 cubic yards.]

No.	Name and address of bidder.	Price per cubic yard.	Total.
		Cents.	
1[a]	William H. Taylor, jr., Jersey City, N. J.	8	$7,200.00
2	William DuBois, New York, N. Y.	12	10,800.00
3	Henry DuBois' Sons, New York, N. Y.	8½	7,425.00

[a] Accepted.

Contract in force June 30, 1897, for dredging in New Haven Harbor, Connecticut.

Name of contractor.	Date of contract.	Date of approval.	Work begun.	Contract expires.
William H. Taylor, jr.	Jan. 7, 1897	Jan. 15, 1897	.....	Dec. 31, 1897

COMMERCIAL STATISTICS FOR THE YEAR 1896.

[Through courtesy of Mr. Henry H. Babcock, collector of customs.]

Foreign.

Value of imports	$265,258
Revenue receipts	58,177
Total	323,435
Foreign vessels:	
Entered	53
Cleared	47
Total	100
Domestic vessels:	
Entered	735
Cleared	730
Total	1,465

Net tonnage of vessels owned at this port.

Steamers	12,334
Sailing vessels	37,257
Barges	17,732
Total	67,323

Arrival and departure of vessels.

[Draft, 6 to 22 feet; tonnage, 100 to 2,600 tons.]

Kind of vessel.	Number of round trips.	Aggregate tonnage of all trips.
Steamers of all kinds	13,250	2,950,000
Sailing vessels	7,500	4,780,000
Barges in tow, scows, etc.	7,900	3,100,000
Total	28,650	10,830,000

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Freight received and shipped, coastwise only.

Chief articles.	Tons.	Estimated value.
Coal received and shipped	875,000	$2,960,000
Iron received and shipped	126,000	4,125,000
Lumber received, 74,000,000 feet	121,000	2,100,000
Oysters, received and shipped	72,000	760,000
Miscellaneous merchandise:		
Received	976,000	110,850,000
Shipped	882,000	129,400,000
Total	3,052,000	250,195,000

The above figures show a decrease in tonnage of freight under that reported for the year 1895 of 243,900 tons, which is the result of diminished business occasioned by the depression of the times.

No new lines of transportation have been established since January 1, 1896.

D 8.

CONSTRUCTION OF BREAKWATERS AT NEW HAVEN, CONNECTICUT.

[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until August 5, 1896.]

On October 28, 1896, bids were opened and a contract entered into with Hughes Brothers & Bangs, the lowest bidders, for placing about 100,000 tons of stone in the breakwaters, at 88 cents per ton. Work was begun November 2, 1896, and completed February 1, 1897, the exact amount placed being 100,676 tons. This sufficed to extend the west breakwater 1,090 feet, making its total length 1,490 feet. Of the total length of breakwaters contemplated in the project, 13,700 feet, there have been built to this date 9,440 feet, leaving 4,260 feet to complete. The part built has not the originally proposed section, but no failures have occurred due to that cause, and in the absence of any, the reduced section would seem to be sufficient.

New Haven, the port of entry for the collection district of New Haven, is situated at the head of New Haven Harbor, about 4 miles north of the breakwaters.

There is a light-house on Southwest Ledge, the west terminus of the east breakwater.

Fort Trumbull, New London Harbor, 42 miles east, is the nearest work of defense.

Money statement.

July 1, 1896, balance unexpended	$102,823.97
June 30, 1897, amount expended during fiscal year	98,700.28
July 1, 1897, balance unexpended	4,123.69
Amount (estimated) required for completion of existing project	1,316,134.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	200,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897	

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Appropriations for constructing breakwater at New Haven, Conn., have been made as follows:

Application.	Date.	Amount.
Easterly breakwater	Mar. 3, 1879	$30,000
Do	June 14, 1880	30,000
Do	Mar. 3, 1881	60,000
Do	Aug. 2, 1882	60,000
Do	July 5, 1884	40,000
Do	Aug. 5, 1886	75,000
Do	Aug. 11, 1888	75,000
Middle or Ludington Rock breakwater	Sept. 19, 1890	120,000
Do	July 13, 1892	120,000
Middle and west breakwaters	Aug. 17, 1894	125,000
West breakwater	June 3, 1896	100,000
Total		835,000

Abstract of proposals for constructing breakwater at New Haven, Conn., opened by Capt. Smith S. Leach, Corps of Engineers, October 28, 1896.

[Estimated tonnage, 100,000 tons.]

No.	Name and address of bidder.	Price per gross ton.	Total.
1a	Hughes Bros. & Bangs, Syracuse, N. Y	$0.88	$88,000.00
2	S. & E. S. Belden, Hartford, Conn	1.07	107,000.00
3	John J. Shipman, Washington, D. C	1.08	108,000.00

a Accepted. Completed February 1, 1897.

No contracts for constructing breakwater at New Haven, Conn., in force June 30, 1897.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

No report for 1896 has been received. The last statement obtained was for 1895, which was as follows:

Vessels passing New Haven Breakwater.

Men-of-war	16
Steamers of all kinds	43,200
Steamships	1,800
Ships, barks, and brigs	1,690
Schooners and sloops of all kinds	54,250
Barges in tow, scows, etc	50,400
Total	151,356

These records are not complete, as some vessels pass unobserved in the night or in thick weather.

During the year past 92 vessels have been observed under and close to the breakwater for refuge, and in the mouth of the harbor, partly under the protection of the breakwaters, 3,925 vessels have been observed.

D 9.

IMPROVEMENT OF HOUSATONIC RIVER, CONNECTICUT.

[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until August 5, 1896.]

Under a contract with R. G. & J. S. Packard, dated May 15, 1896, at 19¾ cents per cubic yard, dredging had been begun on June 18, 1896, and was in progress at the beginning of the fiscal year. By August 29,

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1896, 28,121 cubic yards had been removed from the outer bar, making that channel 9 feet deep and 100 feet wide, and 6,734 yards from the point of the turn in the bend below Stratford, to ease an abrupt turn in the channel, which vessels found difficulty in making at some stages of tide. This work completed the contract.

On February 26, 1897, bids were opened and contracts entered into with S. & E. S. Belden for repairs to the breakwater, estimated at 6,000 tons, at $1.11 per ton; and with J. P. Randerson for dredging, estimated at 50,000 cubic yards, at 23½ cents per cubic yard. The parties named were the lowest bidders in each case. The Belden contract was begun March 19, 1897, and completed May 22, 1897, the exact amount of material placed being 6,652 tons. This work leaves the breakwater in satisfactory condition.

Work under the Randerson contract was begun June 28, 1897, and 1,323 cubic yards had been removed from Mill Bar at the close of the fiscal year.

Under the provision of the river and harbor act of June 3, 1896, a survey of the Housatonic River was made in October, 1896, and a report of revised project was submitted March 16, 1897. This report was published as Doc. No. 16, Fifty-fifth Congress, first session.

The Housatonic River is the boundary between the collection districts of New Haven and Fairfield. The nearest light-house is on Stratford Point, at the mouth of the river. The nearest work of defense is Fort Schuyler, Throgs Neck, about 43 miles to the southwest.

Money statement.

July 1, 1896, balance unexpended		$32,631.78
June 30, 1897, amount expended during fiscal year		17,713.41
July 1, 1897, balance unexpended		14,918.37
July 1, 1897, outstanding liabilities	$313.40	
July 1, 1897, amount covered by uncompleted contracts	11,439.10	
		11,752.50
July 1, 1897, balance available		3,165.87
Amount (estimated) required for completion of existing project		62,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		35,000.00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

Appropriations for improving Housatonic River, Connecticut, have been made as follows:

Application.	Date.	Amount.
Sow and Pigs Jetty, dredging	Mar. 3, 1871	$15,000
Drew Rock Jetty, dredging	June 10, 1872	15,000
Dredging	Mar. 3, 1873	10,000
Do	June 23, 1874	10,000
Do	Mar. 3, 1875	5,000
Do	June 18, 1878	5,000
Do	June 14, 1880	2,000
Do	Mar. 3, 1881	2,000
Removing Drew Rock and Jetty in 1887	Aug. 2, 1882	2,000
Do	July 5, 1884	2,500
Do	Aug. 5, 1886	5,000
Commencing breakwater, dredging	Aug. 11, 1888	35,000
Extending breakwater, dredging	Sept. 19, 1890	35,000
Extending breakwater, dike and dredging	July 13, 1892	20,000
Do	Aug. 17, 1894	25,000
Enlarging breakwater and dredging	June 3, 1896	25,000
Total		213,500

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Abstract of proposals for dredging in the Housatonic River, Connecticut, opened by Capt. Smith S. Leach, Corps of Engineers, December 23, 1896.

[Estimated yardage, 50,000 cubic yards.]

No.	Name and address of bidder.	Price per cubic yard.	Total.
		Cents.	
1*a*	John P. Randerson, Albany, N. Y	23½	$11,750
2	Emory R. Seward, Albany, N. Y	35	17,500
3	Hartford Dredging Co., Hartford, Conn	24	12,000

a Accepted.

Abstract of proposals for enlarging Housatonic Breakwater, Connecticut, opened by Maj. Smith S. Leach, Corps of Engineers, February 26, 1897.

[Estimated tonnage, 6,000 gross tons.]

No.	Name and address of bidder.	Price per gross ton.	Total.
1*a*	S. & E. S. Belden, Hartford, Conn	$1.11	$6,660
2	John Beattie, Leetes Island, Conn	1.20	7,200

a Accepted and work completed.

Contract in force June 30, 1897, for dredging in the Housatonic River, Connecticut.

Name of contractor.	Date of contract.	Date of approval.	Work begun.	Contract expires.
John P. Randerson	Jan. 14, 1897	Feb. 13, 1897	June 28, 1897	Dec. 31, 1897

No contracts in force June 30, 1897, for enlarging Housatonic Breakwater, Connecticut.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

Arrivals and departures of vessels.

AT DERBY, HEAD OF NAVIGATION.

[Draft, 2 to 8 feet; tonnage, 3 to 450 tons.]

	Number of round trips.	Aggregate tonnage of all trips.
Steamers	255	12,750
Sailing vessels	21	4,200
Barges	150	30,000
Total	426	46,950

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Coal	51,000	$230,000
Iron	1,300	16,000
Lumber, 2,856,007 feet	4,284	50,869
Miscellaneous	6,190	58,000
Total	62,774	354,869

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AT STRATFORD, NEAR MOUTH OF RIVER.

[Draft, 2 to 7 feet; tonnage, 3 to 250 tons.]

	Number of round trips.	Aggregate tonnage of all trips.
Steamers	624	31,200
Sailing vessels	200	14,000
Barges	10	2,500
Total	834	47,700

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Coal	2,500	$12,500
Oysters and oyster shells	13,393	42,000
Miscellaneous	480	2,500
Total	16,373	57,000

In addition to the above, about 500 tons of iron water pipe was landed at Bond's dock.

No new lines of transportation have been established in the river since July 1, 1896.

D 10.

IMPROVEMENT OF BRIDGEPORT HARBOR, CONNECTICUT.

[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until August 5, 1896.]

No work was done in this harbor during the fiscal year. Under the appropriation of $28,000 in act of June 3, 1896, a contract has been entered into with George B. Beardsley, the lowest bidder, for dredging 140,000 cubic yards, at 10 cents per cubic yard, which will be completed by December 31, 1897. No work was done under this contract during the fiscal year. The dredging will be applied to widening to 200 feet the 15-foot channel on its east side from the Sound to the Outer Beacon, a distance of about 4,700 feet, and to extending the 15-foot channel from the Outer to the Inner Beacon, a distance of about 1,300 feet with width from 60 to 100 feet.

Official action has been taken by the city of Bridgeport to determine the construction of a drawbridge over Yellow Mill Cove, and plans have been drawn but not yet submitted for approval.

Bridgeport, the port of entry for the collection district of Fairfield, is situated about 2 miles from Long Island Sound, at the head of Bridgeport Harbor. There is a light-house at the entrance to the harbor, and a small harbor light at the Inner Beacon.

Fort Schuyler, Throgs Neck, at the head of Long Island Sound, is about 41 miles to the southwest, and is the nearest work of defense.

Money statement.

July 1, 1896, balance unexpended	$28,181.12
June 30, 1897, amount expended during fiscal year	2,136.17
July 1, 1897, balance unexpended	26,044.95
July 1, 1897, amount covered by uncompleted contracts	14,000.00
July 1, 1897, balance available	12,044.95
Amount (estimated) required for completion of existing project	87,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

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Appropriations for the improvement of Bridgeport Harbor, Connecticut, have been made as follows:

Application.	Date.	Amount.
Dredging outer bar	July 4, 1836	$10,000
Dredging outer and inner bars	Aug. 30, 1852	10,000
Dredging and 521 feet of breakwater	Mar. 3, 1871	20,000
Dredging and 859 feet of breakwater	June 10, 1872	40,000
Dredging inner bar and upper harbor	Mar. 3, 1873	30,000
Dredging bridge to Long Island Sound (9 feet)	June 23, 1874	20,000
Dredging bridge to Long Island Sound (12 feet)	Mar. 3, 1875	15,000
Dredging upper harbor (9 feet)	Aug. 14, 1876	10,000
Dredging above bridge and outer bar (9 and 12 feet)	June 18, 1878	10,000
Dredging bridge to Long Island Sound (12 feet)	Mar. 3, 1879	10,000
Do	June 14, 1880	10,000
Dredging about Inner Beacon (12 feet)	Mar. 3, 1881	10,000
Dredging between Inner Beacon and railroad wharf (12 feet)	Aug. 2, 1882	10,000
Do	July 5, 1884	5,000
Do	Aug. 5, 1886	20,000
Dredging above horse railroad bridge (9 feet)	Aug. 11, 1888	10,000
Dredging and breakwater at Tongue	Sept. 19, 1890	20,000
Dredging between Inner Beacon and Naugatuck Wharf	July 13, 1892	20,000
Dredging outer bar (15 feet)	Aug. 17, 1894	10,000
Dredging	June 3, 1896	28,000
Total		318,000

Abstract of proposals for dredging in Bridgeport Harbor, Connecticut, opened by Capt. Smith S. Leach, Corps of Engineers, December 17, 1896.

[Estimated yardage, 140,000 cubic yards.]

No.	Name and address of bidder.	Price per cubic yard.	Total.
		Cents.	
1*a*	George B. Beardsley, Bridgeport, Conn	10	$14,000.00
2	E. R. Seward, Albany, N. Y	17	23,800.00
3	International Construction Co., Syracuse, N. Y	17	23,800.00
4	Alonzo E. Smith, Islip, N. Y	15	21,000.00

a Accepted.

Contract in force June 30, 1897, for dredging in Bridgeport Harbor, Connecticut.

Name of contractor.	Date of contract.	Date of approval.	Work begun.	Contract expires.
George B. Beardsley	Dec. 28, 1896	Feb. 1, 1897		Dec. 31, 1897

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

[Through courtesy of Capt. John McNeil, harbor master of Bridgeport.]

Arrival and departure of vessels.

[Draft, 6 to 18 feet; tonnage, 50 to 1,250 tons.]

Kind of vessel.	Number of round trips.	Aggregate tonnage of all trips.
Steamers	7,766	1,315,107
Sailing vessels	5,207	
Barges	5,750	
Total	18,723	1,315,107

In addition to the above there are 230 vessels, including small steamers and sailing vessels, engaged in the oyster industry of this port.

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Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Receipts	755,329	$37,998,192
Shipments	275,122	26,758,211
Total	1,030,451	54,756,403

The above figures show an increase of 61,792 tons over that reported for 1895.

There have been 115 vessels of all kinds repaired here during the past year. Owing to business depression, our receipts are a trifle below those of the previous season; but we have noted an increase of business in the past few months, although a dull season.

No new lines of transportation have been established during the year.

D 11.

IMPROVEMENT OF SAUGATUCK RIVER AND WESTPORT HARBOR, CONNECTICUT.

[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until August 5, 1896.]

Under the appropriation in act of June 3, 1896, contracts were entered into for repairing the Cedar Point Breakwater and for removing bowlders from the channel above the railroad bridge. The former contract was made with Dennis Toomey, the lowest bidder, at $3.25 per ton, and was satisfactorily completed between April 7, 1897, and May 5, 1897. Four hundred tons of stone were delivered and placed which sufficed to repair the breakwater for a distance of 234 feet at the shore end and to extend it 30 feet up the beach, leaving the work in good condition.

The second contract was made with T. A. Scott, the lowest bidder, at $7 per ton. Work was begun June 28, 1897, and 36 tons had been removed at the close of the fiscal year.

Saugatuck River is in the Fairfield collection district, of which Bridgeport is the port of entry. The nearest light-house is on Sheffield Island, 5 miles southeast from the river's mouth. Fort Schuyler, Throgs Neck, at the head of Long Island Sound, 32 miles southwest, is the nearest work of defense.

Money statements.

SAUGATUCK RIVER, CONNECTICUT.

July 1, 1896, balance unexpended	$264.90
June 30, 1897, amount expended during fiscal year	264.90

WESTPORT HARBOR, CONNECTICUT.

July 1, 1896, balance unexpended		$3,000.00
June 30, 1897, amount expended during fiscal year		1,670.70
July 1, 1897, balance unexpended		1,329.30
July 1, 1897, outstanding liabilities	$252.00	
July 1, 1897, amount covered by uncompleted contracts	448.00	
		700.00
July 1, 1897, balance available		629.30

Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	5,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

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Appropriations for this harbor have been made as follows:

Title.	Application.	Date.	Amount.
Survey of river and harbor of Saugatuck	Survey	May 20, 1826	$400
Removing obstructions in river and protecting harbor at Cedar Point.	Chiefly constructing breakwater at Cedar Point.		
Removing obstructions in river	As stated, location not known	Apr. 30, 1830	28
For further securing the beach at Cedar Point.	Continuing breakwater	July 4, 1836	1,000
Harbor of Westport	Canal construction	....do	3,900
Do	....do	May 3, 1837	3,734
Do	....do	July 7, 1838	4,782
Deepening and improving Westport Harbor, unexpended balance reverted to Treasury in 1870; reappropriated in 1871.	Chiefly in surveys in 1872	Mar. 2, 1867	2,500
Westport Harbor	Repairing and extending breakwater on Cedar Point.	July 11, 1870	2,500
Saugatuck River, improvement of the natural channel.	Dredging	July 13, 1892	7,000
Saugatuck River, for completion	....do	Aug. 17, 1894	3,000
Westport Harbor, Connecticut	Removal of rocks and repair of breakwater.	June 3, 1896	3,000
Total			32,444

The appropriations since 1892 have been applied to the present project.

Abstract of proposals for repairs to breakwater at Cedar Point, Westport Harbor, Connecticut, opened by Maj. Smith S. Leach, Corps of Engineers, February 26, 1897.

[Estimated tonnage, 350 gross tons.]

No.	Name and address of bidder.	Price per gross ton.	Total.
1	John Beattie, Leetes Island, Conn	$3.75	$1,312.50
2	D. Toomey, Guilford, Conn	3.25	*a* 1,137.50
3	Charles Smedley, New York, N. Y	3.50	1,225.00

a Accepted and completed.

Abstract of proposals for removal of bowlders from Saugatuck River, Connecticut, opened by Maj. Smith S. Leach, Corps of Engineers, February 26, 1897.

[Estimated tonnage, 100 gross tons.]

No.	Name and address of bidder.	Price per gross ton.	Total.
1	John Beattie, Leetes Island, Conn	$10.00	$1,000
2	Thomas A. Scott, New London, Conn	7.00	*a* 700
3	D. Toomey, Guilford, Conn	10.00	1,000
4	James S. Rogers, Plattsburg, N. Y	8.90	890

a Accepted.

No contracts in force June 30, 1897, for repairs to breakwater at Cedar Point, Westport Harbor, Connecticut.

Contract in force June 30, 1897, for removal of bowlders from Saugatuck River, Connecticut.

Name of contractor.	Date of contract.	Date of approval.	Work begun.	Contract expires.
T. A. Scott	Mar. 11, 1897	Mar. 22, 1897	June 28, 1897	July 1, 1897

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COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

Arrival and departure of vessels.

WESTPORT HARBOR.

[Draft, 4 to 10½ feet; tonnage, 50 to 300 tons.]

Kinds of vessels.	Round trips.	Aggregate tonnage of all trips.
Sailing vessels	18	2,707
Steamers of all kinds	177	30,800
Barges, scows, etc.	150	18,000
Total	345	51,507

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Coal	9,200	$46,000
Lumber (425,000 feet B. M.)	637	8,500
Miscellaneous	23,670	710,100
Total	33,507	764,600

The above figures show an increase of 4,567 in tonnage of freight over that reported for the year 1895, which was 28,940 tons.

No new lines of transportation established since January 1, 1896.

D 12.

IMPROVEMENT OF NORWALK HARBOR, CONNECTICUT.

[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until August 5, 1896.]

At the beginning of the fiscal year a contract was pending for dredging at Ferrys Point under the appropriation of 1894. The reasons for the delay in this work are given in the report for 1896, page 714. Work was begun September 14, 1896, and suspended on account of ice December 28, 1896; resumed April 8, 1897, and completed May 28, 1897.

The amount removed from Ferrys Point is 78,720 cubic yards, and the area between the channel and the probable harbor line has been deepened to 6 feet below mean low water, as required by law. A small balance was applied at Oyster Shell Point, immediately below, where relief was much needed. Ten thousand cubic yards was removed from this locality. This balance was not required at Keysers Island, mentioned in the act of Congress, as all work needed there had been done under the appropriation of 1896, before Ferry's Point was entirely removed.

On December 17, 1896, bids were opened and a contract entered into with George B. Beardsley, the lowest bidder, for dredging an approximate amount of 70,000 cubic yards from the channel below the railroad bridge at 8 cents per yard. Operations were begun December 31, 1896, and completed March 24, 1897. The amount removed was 77,000 cubic yards.

Attention was given to widening the channel at close points rather than to securing a greater draft throughout, as the former seemed more urgent than the latter. All areas worked on were dredged to the project

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depth of 10 feet below mean low water. There were 7,700 cubic yards removed from Keysers Island, 52,593 yards from the turn at Black Buoy, and 16,707 yards opposite the South Norwalk docks. A pile of rocks obstructing the channel above Dorlans Point was removed under special authority of the Chief of Engineers, at a cost of $70.

Norwalk is in the Fairfield collection district, and is 11 miles west of Bridgeport, the port of entry. Norwalk light-house is on Sheffield Island, at the harbor entrance. The nearest work of defense is Fort Schuyler, Throgs Neck, at the head of Long Island Sound, about 29 miles southwest.

Money statement.

July 1, 1896, balance unexpended	$24,181.49
June 30, 1897, amount expended during fiscal year	23,625.51
July 1, 1897, balance unexpended	555.98
July 1, 1897, outstanding liabilities	16.95
July 1, 1897, balance available	539.03
Amount (estimated) required for completion of existing project	52,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

Appropriations for improving Norwalk Harbor, Connecticut, have been made as follows:

Application.	Date.	Amount.
For previous projects:		
Dredging (6 feet) above Norwalk	June 10, 1872	$10,000
Do	Mar. 3, 1873	10,000
Do	June 23, 1874	10,000
Dredging (6 feet) below South Norwalk	Mar. 3, 1875	7,000
Do	June 18, 1878	6,000
Dredging (6 feet) above and below South Norwalk	Mar. 3, 1879	10,000
Dredging (6 feet) below South Norwalk	June 14, 1880	5,000
Dredging (8 feet) below and (6 feet) above South Norwalk	Mar. 3, 1881	5,000
Dredging (6 feet) above South Norwalk	Aug. 2, 1882	5,000
Dredging (8 feet) below South Norwalk	July 5, 1884	5,000
Dredging (6 feet) above South Norwalk	Aug. 5, 1886	3,000
Dredging (6 feet) above and (8 feet) below South Norwalk	Aug. 11, 1888	3,000
Do	Sept. 19, 1890	4,000
Total		83,000
For present project, adopted 1894:		
Dredging (6 feet) at Ferrys Point	Aug. 17, 1894	15,000
Dredging (not yet expended)	June 3, 1896	10,000
Total for present project		25,000
Total appropriated for improvement of Norwalk Harbor, Connecticut		108,000

Abstract of proposals for dredging in Norwalk Harbor, Connecticut, opened by Capt. Smith S. Leach, Corps of Engineers, December 17, 1896.

[Estimated yardage, 70,000 cubic yards.]

No.	Name and address of bidder.	Price per cubic yard.	Total.
		Cents.	
1	George B. Beardsley, Bridgeport, Conn.	8¼	*a* $5,950
2	R. R. Seward, Albany, N. Y.	12½	9,450
3	International Contracting Co., Syracuse, N. Y.	13	9,100
4	Alonzo E. Smith, Islip, N. Y.	18	12,600
5	William H. Taylor, jr., Jersey City, N. J.	12	8,400

a Completed.

No contracts in force for dredging in Norwalk Harbor, Connecticut, June 30, 1897.

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COMMERCIAL STATISTICS FOR CALENDAR YEAR 1896.

Arrivals and departures of vessels.

[Draft, 4 to 14 feet; tonnage, 50 to 600 tons.]

Kinds of vessels.	Round trips.
Steamers of all kinds	605
Sailing vessels	131
Barges	257
Total	993

The above does not include the frequent trips made by 43 oyster steamers (total tonnage, 2,505 gross tons) and numerous small sailboats employed in the oyster industry.

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Coal	73,790	$310,585
Building materials	24,755	109,514
Miscellaneous materials	43,500	4,614,250
Oysters and shellfish	4,000	150,000
Total	146,045	5,184,349

The above figures show a decrease of 55,050 tons over the report for the calendar year 1895, when 201,095 tons were reported, but the estimated value of the freight is $212,762 greater for 1896 than for 1895.

No new lines of transportation have been established during the year.

D 13.

IMPROVEMENT OF FIVE MILE RIVER HARBOR, CONNECTICUT.

[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until August 5, 1896.]

The adopted project for this harbor consists in dredging a channel 8 feet deep at mean low water, and 100 feet wide, to extend up the harbor about 6,000 feet.

During the fiscal year a contract was entered into with George B. Beardsley, the lowest bidder, for the removal of about 20,000 cubic yards of material, at 8½ cents per cubic yard. This work is to be completed by December 31, 1897. At the close of the fiscal year no work had been done under this contract.

Under the programme approved for the expenditure of the last appropriation, this dredging will be applied to widening the present channel from 60 to 100 feet, beginning at the lower end and extending upward an estimated distance of 2,500 feet.

Five Mile River is in the Fairfield collection district and is about 13 miles west of Bridgeport, the port of entry. The nearest light-house is on Sheffield Island, nearly 2 miles from the mouth of the harbor. The nearest work of defense is Fort Schuyler, at the head of Long Island Sound, 27 miles southwest.

Money statement.

July 1, 1896, balance unexpended	$2,872.17
June 30, 1897, amount expended during fiscal year	180.01
July 1, 1897, balance unexpended	2,692.16
July 1, 1897, amount covered by uncompleted contracts	1,700.00
July 1, 1897, balance available	992.16
Amount (estimated) required for completion of existing project	25,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

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Appropriations for improving harbor at Five Mile River, Connecticut, have been made as follows:

Application.	Date.	Amount.
Dredging	Aug. 11, 1888	$5,000
Do	Sept. 19, 1890	5,000
Do	July 13, 1892	5,000
Do	Aug. 17, 1894	2,500
Not yet expended	June 3, 1896	2,500
Total		20,000

Abstract of proposals for dredging in Five Mile River Harbor, Connecticut, opened by Capt. Smith S. Leach, Corps of Engineers, December 17, 1896.

[Estimated yardage, 20,000 cubic yards.]

No.	Name and address of bidder.	Price per cubic yard.	Total.
		Cents.	
1	George B. Beardsley, Bridgeport, Conn	8½	a$1,700
2	Edgar M. Payn, Albany, N. Y	20⅞	4,175
3	Newburg Dredging Co., Newburg, N. Y	12	2,400
4	Alonzo E. Smith, Islip, N. Y	24	4,800
5	William H. Taylor, jr., Jersey City, N. J	12¾	2,550
6	John P. Randerson, Albany, N. Y	14	2,800

a Accepted.

Contract in force June 30, 1897, for dredging in Five Mile River Harbor, Connecticut.

Name of contractor.	Date of contract.	Date of approval.	Work begun.	Contract expires.
George B. Beardsley	Dec. 28, 1896	Feb. 1, 1897		Dec. 31, 1897

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

These statistics have been asked for, but have not been received. The last report received was for 1895, as follows:

Arrivals and departures of vessels.

Kind of vessel.	Round trips.
Steamers (including oyster steamers)	400
Sailing vessels	325
Barges	14
Total	739

Draft and tonnage not reported. Aggregate tonnage of all trips not ascertained.

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Receipts:		
Coal, oysters	3,250	$137,450
Miscellaneous (not otherwise included)	240	(a)
Total receipts	3,598	137,450
Shipments:		
Oysters, produce, etc., of which 4,000 tons were oysters for shipment to Europe	4,700	194,220
Other transactions in oysters and clams, sales to dealers, planters, and consumers, about	3,000	110,452
Total shipments	7,700	304,672

a Not reported.

No new lines of transportation established since January 1, 1896.

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D 14.

IMPROVEMENT OF STAMFORD HARBOR, CONNECTICUT.

[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until August 5, 1896.]

The approved project for this harbor consists in dredging to make channels in the East and West branches. That in the West Branch is to be about 1½ miles long, 150 feet wide, and 7 feet deep at mean low water, with a basin between harbor lines at its head, and the one in the East Branch 9,200 feet long, 9 feet deep at mean low water, and 150 feet wide for the lower 8,000 feet and 50 feet wide above. The channel in the East Branch has been excavated full length and depth, but with reduced width. That in the West Branch has been dug to full depth and reduced width for about half its length.

Under the approved programme for the expenditure of the appropriation of $10,000 in act of June 3, 1896, bids were opened and a contract entered into with Frank H. Brainard, the lowest bidder, for dredging from the West Branch about 80,000 cubic yards at 9½ cents per cubic yard.

Work on this contract was begun on June 23, and at the close of the fiscal year 7,034 cubic yards of material had been removed. The contract should be completed in about three months and will extend the channel at 7 feet depth and 115 feet width from Cooks Point up the harbor about 3,000 feet.

Stamford Harbor is in the Fairfield collection district, of which Bridgeport is the port of entry. There is a light-house on the middle-ground at the harbor entrance. The nearest work of defense is Fort Schuyler, Throgs Neck, 20 miles to the southwest.

Money statement.

July 1, 1896, balance unexpended		$10,625.05
June 30, 1897, amount expended during fiscal year		1,348.10
July 1, 1897, balance unexpended		9,276.95
July 1, 1897, outstanding liabilities	$668.23	
July 1, 1897, amount covered by uncompleted contracts	6,931.77	
		7,600.00
July 1, 1897, balance available		1,676.95
Amount (estimated) required for completion of existing project		88,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

Appropriations for improving Stamford Harbor, Connecticut, have been made as follows:

Application.	Date.	Amount.
For previous projects:		
Dredging West Branch 5 feet deep	Aug. 5, 1886	$10,000
Do	Aug. 11, 1882	5,000
Do	Sep. 19, 1890	5,000
Total		20,000
For the present project:		
Dredging and rock removal, East Branch, $13,800; dreding West Branch, $1,200	July 13, 1892	15,000
Dredging and rock removal, East Branch, $5,000; dredging West Branch, $5,000	Aug. 17, 1894	10,000
Not yet expended	June 3, 1896	10,000
Total		35,000

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Abstract of proposals for dredging in Stamford Harbor, Connecticut, opened by Capt. Smith S. Leach, Corps of Engineers, December 17, 1896.

[Estimated yardage, 80,000 cubic yards.]

No.	Name and address of bidder.	Price per cubic yard.	Total.
		Cents.	
1	Edgar M. Payn, Albany, N. Y.	20 9/10	$16,720
2	Newburgh Dredging Co., Newburgh, N. Y	18 3/4	11,100
3	E. R. Seward, Albany, N. Y.	14 3/4	11,600
4	Frank H. Brainard, New York, N. Y	9 3/4	a 7,600
5	Alonso E. Smith, Islip, N. Y.	16	12,800
6	Hartford Dredging Co., Hartford, Conn	10 4/10	8,320
7	Wm. H. Taylor, jr., Jersey City, N. J	14	11,200
8	John P. Randerson, Albany, N. Y.	12 1/4	9,800

a Accepted.

Contract in force June 30, 1897, for dredging in Stamford Harbor, Connecticut.

Name of contractor.	Date of contract.	Date of approval.	Work begun.	Contract expires.
Frank H. Brainard	Dec. 28, 1896	Jan. 15, 1897	June 23, 1897	Dec. 31, 1897

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

[Through the courtesy of Mr. E. B. Goddard, deputy collector of customs.]

Arrival and departure of vessels.

[Draft, 5 to 15 feet; tonnage, 20 to 550 tons.]

Kind of vessel.	Round trips.
Steamers	1,166
Sailing vessels	407
Barges	637
Total	2,210

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Coal	84,258	$381,005
Building materials	49,500	460,000
Miscellaneous	240,000	10,475,643
Total	373,758	11,316,647

The above figures show an increase of 153,252 tons of freight above that reported for 1895, which was 220,506 tons.

Lines of transportation established since January 1, 1896: The steam screw vessel *Defender* has been running to Northport, L. I., since May 1, 1897, and is known on the Stamford and Northport Ferry Line.

This report includes all the harbor of Stamford, east and west sides.

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D 15.

IMPROVEMENT OF HARBOR AT COS COB AND MIANUS RIVER, CONNECTICUT.

[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until August 5, 1896.]

The approved project for the harbor consists in dredging a channel 1½ miles in length, 6 feet deep at mean low water, 150 feet wide to the bridge, two-fifths mile, and 100 feet wide to the head, four-fifths mile, together with a turning basin near the lower end 300 by 1,750 feet. The upper half mile of the channel and the basin remain to be done.

Under the approved programme for the expenditure of the appropriation of $8,000 in act of June 3, 1896, bids were opened and a contract entered into with William H. Taylor, jr., the lowest bidder, for dredging about 60,000 cubic yards from the basin, at 9 cents per cubic yard. This quantity should cover half of the basin.

Work under the contract was begun June 30, and 1,876 cubic yards of material were taken out before the close of the fiscal year. The contract will be completed in about two months.

Cos Cob Harbor and Mianus River are in the collection district of Fairfield, Conn., of which Bridgeport is the port of entry. The nearest light-house is on Great Captains Island, about 2 miles southwest from the harbor entrance. Fort Schuyler, Throgs Neck, New York, 18 miles to the southwest, is the nearest work of defense.

Money statement.

July 1, 1896, balance unexpended		$8,420.29
June 30, 1897, amount expended during fiscal year		862.70
July 1, 1897, balance unexpended		7,557.59
July 1, 1897, outstanding liabilities	$168.84	
July 1, 1897, amount covered by uncompleted contracts	5,231.16	
		5,400.00
July 1, 1897, balance available		2,157.59
Amount (estimated) required for completion of existing project		35,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

Appropriations for improving Cos Cob Harbor and Mianus River have been made as follows:

Application.	Date.	Amount.
Dredging below railroad bridge	July 13, 1892	$7,000
Dredging above railroad bridge	Aug. 17, 1894	4,000
Not yet expended	June 3, 1896	8,000
Total		19,000

Abstract of proposals for dredging in Cos Cob Harbor and Mianus River, Connecticut, opened by Capt. Smith S. Leach, Corps of Engineers, December 17, 1896.

[Estimated yardage, 60,000 cubic yards.]

No.	Name and address of bidder.	Price per cubic yard.	Total.
		Cents.	
1	Edgar M. Payn, Albany, N. Y.	21½	$13,125
2	Newburgh Dredging Co., Newburg, N. Y.	15	9,000
3	Alonzo E. Smith, Islip, N. Y.	14	8,400
4	Hartford Dredging Co., Hartford Conn.	9⅞	5,580
5	Wm. H. Taylor, jr., Jersey City, N. J.	9	*a* 5,400
6	John P. Randerson, Albany, N. Y.	11¾	7,050
7	James McSpirit, Jersey City, N. J.	13⅜	8,280

a Accepted.

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Contract in force June 30, 1897, for dredging in Cos Cob Harbor and Mianus River, Connecticut.

Name of contractor.	Date of contract.	Date of approval.	Work begun.	Contract expires.
Wm. H. Taylor, jr	Dec. 30, 1896	Jan. 15, 1897	June 30, 1897	Dec. 31, 1897.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

These statistics have been asked for, but have not been received. The last report received (1894) was as follows:

Arrivals and departures of vessels.

[Draft, 4 to 8 feet; tonnage, 25 to 100 tons.]

Kind of vessel.	Vessels.	Round trips.	Aggregate tonnage of all trips.
Steamers	6	90	2,400
Sailing vessels	60	240	48,000
Barges	2	12	1,200
Total	68	342	51,600

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Receipts:		
Coal, timber, oysters, shipbuilding materials, hardware, and general merchandise	11,100	$57,500
Shipments:		
Ice, car sweepers, oysters, fish, and farm products	40,500	245,500
Total	51,600	303,000

The Riverside Yacht Club has 80 yachts in its fleet, most of which anchor in the harbor.

No new lines of transportation have been established since January 1, 1896.

D 16.

IMPROVEMENT OF GREENWICH HARBOR, CONNECTICUT.

[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until August 5, 1896.]

The approved project for this harbor is to dredge a channel 90 feet wide from the mouth of the harbor to a causeway at its head, to be 9 feet deep at mean low water to the lower docks, and 6 feet deep above. The upper end is to be slightly enlarged to form a turning basin.

Under the appropriation of $6,000 in act of June 3, 1896, a survey was made in July, 1896, and a report submitted September 26, 1896. This report made definite the amount and location of work to be done. Bids for the work were opened December 17, 1896, and a contract entered into with the Hartford Dredging Company, the lowest bidder, to excavate about 35,000 cubic yards at 10.7 cents per cubic yard. The

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work is to be completed by December 31, 1897. No work had been done under the contract at the close of the fiscal year.

Under the programme approved for the expenditure of the last appropriation, the dredging will be applied to the opening of the upper part of the projected channel, giving 6 feet depth at mean low water where there is now practically none.

Greenwich Harbor is in the collection district of Fairfield, Conn., of which Bridgeport is the port of entry. The nearest light-house is on Great Captains Island, about 2 miles southward. The nearest work of defense is Fort Schuyler, Throgs Neck, New York, about 16 miles to the southwest.

Money statement.

July 1, 1896, balance unexpended	$6,000.00
June 30, 1897, amount expended during fiscal year	610.91
July 1, 1897, balance unexpended	5,389.09
July 1, 1897, amount covered by uncompleted contracts	3,745.00
July 1, 1897, balance available	1,644.09
Amount (estimated) required for completion of existing project	14,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	14,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

The only appropriation for improving Greenwich Harbor, Connecticut, is the one of $6,000 made by the river and harbor act of June 3, 1896.

Abstract of proposals for dredging in Greenwich Harbor, Connecticut, opened by Capt. Smith S. Leach, Corps of Engineers, December 17, 1896.

[Estimated yardage, 35,000 cubic yards.]

No.	Name and address of bidder.	Price per cubic yard.	Total.
		Cents.	
1	Edgar M. Payn, Albany, N. Y.	20½	$7,087.50
2	Newburgh Dredging Co., Newburg, N. Y.	12	4,200.00
3	Alonzo E. Smith, Islip, N. Y.	18	6,300.00
4	Hartford Dredging Co., Hartford, Conn.	10 7/10	*a* 3,745.00
5	Wm. H. Taylor, jr., Jersey City, N. J.	12	4,200.00
6	John P. Randerson, Albany, N. Y.	17⅜	6,212.50
7	James McSpirit, Jersey City, N. J.	15 1/10	5,530.00

a Accepted.

Contract in force June 30, 1897, for dredging in Greenwich Harbor, Connecticut.

Name of contractor.	Date of contract.	Date of approval.	Work begun.	Contract expires.
Hartford Dredging Co.	Dec. 30, 1896	Feb. 10, 1897	.....	Dec. 31, 1897

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

These statistics have been asked for but have not been received. The only report received was for 1894, which estimated the tonnage of freight received and shipped as 110,000 tons, valued at $2,835,000.

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D 17.

SURVEY OF NIANTIC HARBOR, CONNECTICUT.

[Printed in House Doc. No. 109, Fifty-fourth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 10, 1896.

SIR: I have the honor to submit the accompanying copy of report, dated December 4, 1896, by Capt Smith S. Leach, Corps of Engineers, upon survey of Niantic Harbor, Connecticut, provided for by the river and harbor act of June 3, 1896.

Comparing the results of this survey with the information obtained by a survey of the locality made in 1872 and a preliminary examination in 1885, Captain Leach finds that, while during the past ten years the harbor depths have not deteriorated and would seem to have actually increased, the volume of traffic has remained the same; also, that the present traffic is not commensurate with the cost of even the smallest measure of improvement. In view of the facts and considerations set forth, he is of the opinion that Niantic Harbor and River are not worthy of improvement by the United States, either with a view to securing increased channel dimensions or constructing a harbor of refuge.

The views of the district officer are concurred in by the division engineer, Col. John M. Wilson, Corps of Engineers, and by me.

Very respectfully, your obedient servant,

W. P. CRAIGHILL,
Brig. Gen., Chief of Engineers.

Hon. DAN. S. LAMONT,
Secretary of War.

LETTER OF COL. JOHN M. WILSON, CORPS OF ENGINEERS.

WASHINGTON, D. C., *December 7, 1896.*

GENERAL: I have the honor to transmit herewith a report from Capt. S. S. Leach, Corps of Engineers, dated December 4, 1896, upon the survey of Niantic Harbor.

I concur in the views expressed by the local engineer.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Colonel of Engineers.

Brig. Gen. W. P. CRAIGHILL,
Chief of Engineers, U. S. A.

REPORT OF CAPT. SMITH S. LEACH, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
New London, Conn., December 4, 1896.

GENERAL: Pursuant to instructions contained in Department letter of September 5, 1896, I have the honor to inform you that a survey of Niantic Harbor has been made and to submit the accompanying map* of the same and the following report thereon:

Niantic Bay is the first pronounced indentation of the Connecticut

* Not printed.

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shore west of the Thames River. It is about 2 miles in average width and 2¼ miles in extreme length. The bottom, generally considered, presents two flat terraces of considerable area, one of 14 feet and the other of 3½ fathoms depth at mean low water. In the deeper portion are several isolated rocks and shoals, but they are mostly toward the shores and leave the central part unobstructed. It is altogether a fine natural harbor, and is much frequented by local fishing craft and yachts. The mean tidal oscillation is about 2½ feet.

Niantic River, which debouches at the head of the bay, is a small stream with a navigable length of about 3 miles. The upper half has banks about 800 feet apart, while the lower half meanders through a tidal flat half a mile in width, which was originally a part of the bay, but is cut off from it by a causeway. The tidal basin above the bridge fills and empties through the draw of the highway bridge and one bay adjoining, presenting an aggregate opening of 114 feet in width. The mean rise and fall of the tide at the head of the river is but a fraction of a foot less than in the bay, but the strength of the tide through the draw is considerable.

The depths in the river range from 6 to 15 feet, and there is a practicable channel of 6 feet at mean low water, except at one point about halfway up, where the 6-foot contours are separated by 120 feet, and a sounding of 5.4 feet is shown between them. Most of the upper half of the river is a pool of 14 or 15 feet depth.

The river is separated from the bay by a well-defined bar just below the bridge, on which the 6-foot contours approach within 200 feet of each other, with soundings of 5.1 and 5.2 feet between them.

In 1872 a survey of Niantic River was made and a report submitted with a project for a channel 100 feet wide and 9 feet deep over the outer bar, and 8 feet deep, with width not specified, from the bridge to the head of navigation. The project also included sand catches to arrest the littoral drift onto the outer bar, and was estimated to cost $26,000, with dredging figured at 25 and 30 cents. This report lays stress upon the obstruction of navigation by the narrow draw openings of the railroad and highway bridges, reported as 26 feet. The railroad bridge has since been rebuilt, and now has a draw opening of 46 feet. The opening of the highway bridge is 28 feet, but can be made 40 feet by the simple expedient of retiring the fender guard of the pivot pier, which is 12 feet farther from the pier than is necessary. The subject was again taken up in 1885, and a preliminary examination was ordered, and a report made with a project for dredging similar to the foregoing, but involving a smaller quantity of material, and estimated to cost $8,000, at 20 cents a yard.

The business of this port was not given in tons in 1872, but the statement was made that the amount of customs dues collected during the preceding fiscal year had been $72,601.14. In 1885 it was reported that there was no customs officer at Niantic and that the aggregate commerce of the port was 2,500 to 3,000 tons per annum. From the best data which can be gathered the present annual commerce of the port is about 3,000 tons, one-half of which is landed at a wharf just inside the highway bridge, and which would receive no benefit except from work done on the outer bar.

So far as navigable depth is concerned, it appears that this harbor, with great natural advantages, enjoys but an insignificant commerce. While during the past ten years the depth has certainly not deteriorated, and seems from a comparison of the surveys to have actually increased, the volume of traffic has remained the same. Under such

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conditions it is futile to expect a greater traffic to follow an increased depth. As the present traffic is not commensurate with the cost of even the smallest measure of improvement, it does not appear advisable to attempt any channel enlargement.

The needs of the locality have been presented in another light. The bay, with its natural advantages as a harbor of refuge, is much exposed to southerly winds, which, coming through The Race, are severe and accompanied by heavy seas. To supplement the natural shelter by a breakwater would make Niantic Bay an excellent refuge in all weathers. If a harbor of refuge were needed in this locality, this would be a suitable place to make it. At present the necessity does not justify a recommendation to that effect.

In view of all the foregoing facts and considerations, I am of the opinion that Niantic Harbor and River are not worthy of improvement by the United States.

Niantic is in the collection district of New London. The nearest light is Bartlett Reef light-ship, 4½ miles distant. The nearest work of defense is Fort Trumbull, distant by water 7 miles.

Respectfully submitted.

SMITH S. LEACH,
Captain, Corps of Engineers.

Brig. Gen. W. P. CRAIGHILL,
Chief of Engineers, U. S. A.
(Through the Division Engineer.)

D 18.

SURVEY OF NEW HAVEN HARBOR, CONNECTICUT.

[Printed in House Doc. No. 82, Fifty-fifth Congress, first session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., July 8, 1897.

SIR: Section 1 of the river and harbor act of June 3, 1896, in the item of appropriation for improving harbor at New Haven, Conn., directs that the Secretary of War make a resurvey and submit plans and estimates for the improvement of said harbor, and section 9 of the aforesaid act directs the Secretary of War, at his discretion, to cause a survey to be made at New Haven Harbor, with cost of improvement to be estimated.

The duty of making the survey thus called for was assigned to the officer in local charge of the improvement of the harbor, and I have now the honor to submit the accompanying copy of report, dated June 23, 1897, with map,* by Maj. Smith S. Leach, Corps of Engineers, upon the subject.

The project of improvement submitted provides for the formation, by dredging, of a channel 20 feet deep at mean low water from Long Island Sound to Tomlinson's bridge, including three interior basins, affording separate anchorages, with depths of 20, 16, and 12 feet, for deep-draft, light-draft, and pleasure vessels, respectively, and connected by ade-

* Not reprinted. Printed in House Doc. No. 82, Fifty-fifth Congress, first session.

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quate channels. From Tomlinson's bridge a channel 200 feet wide and 12 feet deep is projected up Quinnipiac River to Grand avenue, and up Mill River to Chapel street, the Mill River Channel to be continued to Grand avenue in two branches, one on each bank, each branch to have a width of 75 feet and depth of 12 feet. The cost of the project is estimated at $400,000.

It is the opinion of Major Leach that the harbor is worthy of improvement by the General Government on the plans and to the extent set forth in the report, and his views are concurred in by the division engineer, Col. G. L. Gillespie, Corps of Engineers.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF MAJ. SMITH S. LEACH, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
New London, Conn., June 23, 1897.

GENERAL: I have the honor to present the following report upon a resurvey of the harbor of New Haven, Conn., made in pursuance of a proviso in the river and harbor act of June 3, 1896, which directed the Secretary of War to make such a resurvey of this harbor, and to submit plans and estimates for the improvement thereof:

The work was assigned to Maj. H. M Adams, Corps of Engineers, my predecessor in charge of New Haven Harbor, in Department letter of June 19, 1896, and the field work was executed under his direction between July 25 and August 12, 1896, by a party in charge of Mr. H. B. Gorham, assistant engineer. The scope of the survey was limited to a resounding of the areas likely to be involved in the projects for improvement and of those where changes in the regimen of the harbor might be looked for. The soundings were taken with the same degree of care as in former surveys in order to make the results comparable. A map of the survey, in two sheets, is transmitted herewith.

New Haven Harbor is a natural one, formed by an indentation of the north shore of Long Island Sound, about 4 miles long and 1 to 2 miles wide. Two small streams, the Quinnipiac and Mill rivers, discharge into the upper end of the harbor. The relief of the bottom is characteristically a central channel, bordered on each side by very shoal areas. The easterly half of the area between the outer headlands is occupied by numerous rocks and detached ledges; but for these the 24-foot contour would apparently run smoothly from point to point. The westerly half of the mouth is flat and regular. The mean rise of tides is 6.1 feet, and as the tidal reservoir is small in comparison with the channel area, low velocities are to be expected. Measurements made in 1879 show maxima of 1 foot per second, with no decided difference between ebb and flood.

The harbor channel varies in width from 400 feet to 1 mile. The increase is gradual from the head to the vicinity of Fort Hale, about halfway down, where it widens more abruptly, and here a sea bar has been deposited. It is composed of very soft mud to the greatest depth yet sounded, and is about a mile in length between the 16-foot con-

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tours, the minimum depth being 13 feet. It is known locally, and referred to in the reports, as the Fort Hale Bar. The map of 1890, reproduced in the Report of the Chief of Engineers for 1896, part 1, page 702, is approximately correct for the present date, and the harbor is also shown on Coast Survey charts 115 and 362.

This harbor has been under improvement since 1867, though the project for deepening the channel dates from 1870 only. In its unimproved condition the available low-water depths were 9 feet from the city wharves to Cranes Bar, about one-third down; thence to Fort Hale Bar, 16 feet or over; across the bar the depth was 13 feet, and from the lower edge of the bar ample depth could be carried to the Sound. The history of the improvement and the inception and progress of the several projects are fully detailed in the Report of the Chief of Engineers for 1895, page 777 et seq. Dredging for 16 feet depth at mean low water was begun as early as 1872, and the present project, so far as depth is concerned, may be said to date from that year. In the present condition of the improvement there is a channel 16 feet deep at mean low water, 400 to 700 feet wide from Tomlinson's Bridge to Fort Hale Bar, and a channel 16 feet deep and 100 feet wide across the bar. The pending project has in view the widening of the latter to 400 feet. The results thus far attained have been secured by dredging and by the construction of a dike on the west side of the bar.

This dike was built for the purpose of directing and accelerating the tidal currents across the bar, and after the failure of a cut dredged in 1872 and 1873 had indicated an apparent necessity for some concentration of flow. A later experiment in dredging shows that such necessity is apparent only, and that the filling up of the former cut was due, in large part at least, to defective location. In October and November, 1895, a cut 100 feet wide and 16 feet deep was dredged through the bar nearly in the axis of the natural channel. The present survey, and a prior one in January, 1896, show no impairment of the depths secured by this dredging. This evidence is, of course, not conclusive as to the permanence of such a cut, as the period of observation is too short, but such a conclusion is sustained by the general behavior of the harbor as disclosed by comparison of the surveys of 1871, 1880, 1886, 1890, and 1896. From such comparison it clearly appears that the bed of the harbor generally is of an exceedingly stable character. With a single exception, the elevation of the bottom, as determined by soundings at the epochs named, has not changed by amounts greater than the probable errors of the soundings themselves. The exception noted is Fort Hale Bar, already described. Here a comparison of four cross sections from the different surveys shows changes in the elevation of the bottom ranging from 1 to 3 feet.

The different soundings exhibit a bar crest fluctuating in an apparently accidental manner. No evidence appears of a persistent tendency to fill or to scour, either permanently or in cycles. The changes must be referred to extraneous, accidental causes, among which the force of heavy storms, the dragging of keels, the wash of propellers, and the planting and dredging of oysters are probable.

When dredged channels of desired dimensions are reasonably permanent, no other method of improvement need be considered. Such appears to be the case in New Haven Harbor, even for Fort Hale Bar, which is the most critical point. It would be a mistake, however, to dig a channel through the bar of greater width than is urgently required. The fluctuations of the bottom, already noticed, and the short period

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which the present narrow cut has been under observation, make it imprudent, in opening such a channel, to sacrifice any condition which makes for permanency. Comparative narrowness is believed to be such a condition, as it will better control the current, and will also, by compelling many vessels to follow the same track, concentrate the useful effect of their passage.

The commerce of the port of New Haven in 1896 was reported at 3,250,000 tons. So far as the tonnage movement is an index of commercial importance, New Haven deserves to rank with Charleston. No doubt can be entertained that this harbor is worthy of radical improvement, or of the propriety of presenting a liberal project. From a memorial recently prepared by the Chamber of Commerce of New Haven it appears that there are at least 124 vessels of all classes regularly visiting the port which draw 16 feet—the project depth—or over. Of these 10 draw 20 feet or over, 29 draw 19 feet, and 27 draw 18 feet. It is true that all these vessels can enter the harbor at high tide, but as there are no anchorage areas of greater depth than 16 or 17 feet at low water, they must ground at each tide until discharged, and can only be moved from anchorage to dock at a certain stage of the tide. Such restrictions do not appear to be those which commerce can be reasonably expected to endure, and it seems necessary to adopt a depth of channel at least equal at mean low water to the greatest draft of vessels not wholly exceptional. Hence, the depth at mean low water under the project now presented is taken at 20 feet from the Sound to Tomlinson's bridge.

It should be noted that a 20-foot channel through the bar will have its outer end but 600 yards inside of the line of breakwaters. At this point cross tides may be expected, and possibly some greater difficulty in maintaining the cut than has been experienced on the crest of the bar. This difficulty is thought to be a matter of cost of maintenance only, and not to touch the feasibility of the project. As already intimated, the channel across the bar should be as narrow as the requirements of navigation permit. Such a channel will form no part of the anchorage of the outer or inner harbor, and need be considered only as a thoroughfare. In this sense the present projected width of 400 feet seems adequate for all steam vessels. To maintain a deep channel wide enough for sailing vessels to enter the harbor under their own power is beyond the range both of reasonable cost and probable success.

Above the bar space is required for navigation and for anchorage. It does not seem necessary to provide a depth of 20 feet over an area sufficient for the entire commerce of the port, which is visited by a large number of vessels of less draft. There is a limited area of 20 feet natural depth a short distance above the bar, opposite the point of the sand spit known as the "Beach." The adjacent areas are of but slightly less depth, and a 20-foot anchorage one-half mile long and 1,000 feet wide can be made, with a 20-foot channel 300 feet wide along its western edge. This should suffice for the deep vessels, if reserved for their sole use, which can be done by proper enforcement of port regulations. To permit such regulations to be made and enforced an anchorage of equal area, but of 16 feet depth, is provided on the west side of the channel, immediately above the former. This should accommodate all the light-draft commercial vessels. The pleasure fleet still remains to be provided for. In the summer season the port is visited by many yachts, and one of the greatest difficulties now experienced is the obstruction to navigation by yachts anchored in the channel, which is

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the only anchorage now available for the deeper class. A depth of 12 feet at mean low water will suffice for this class of vessels, and a basin of that depth is provided. It is not so large as might be desired, but it includes all the available space adjacent to the clubhouse, and such craft can be crowded with less risk than laden vessels.

These three basins afford anchorage for all classes of vessels, and leave a 20-foot channel, 300 feet wide, clear at all times for vessels under way. The 20-foot channel and the 20, 16, and 12 foot anchorage basins above outlined embrace the part of the harbor now under improvement in accordance with the pending project, and are designed to increase the capacity of that part to correspond with the increase in the number and draft of vessels frequenting the port.

The increase of terminal facilities in other parts of the harbor seems to justify the extension of the improvement to districts not heretofore contemplated. By the construction of drawbridges the city of New Haven has opened the Quinnipiac and Mill rivers to the head of navigation. The new drawbridge over the Quinnipiac at Grand avenue is approaching completion, and the Secretary of War has recently approved plans for a new bridge to replace the present one over Mill River, at East Chapel street.

Harbor lines have been established on both banks of Mill River to the railroad crossing. On Quinnipiac River the harbor lines on the east bank extends to Grand Avenue Bridge, and on the west bank to Lewis's bridge. Industrial plants are multiplying along the banks, and access to them through a channel practicable at all stages of tide is needed. To meet this demand a channel 200 feet wide and 12 feet deep is projected up Quinnipiac River to Grand avenue, and up Mill River to Chapel street. The Mill River channel is continued to Grand avenue in two branches, one on each bank, and each 75 feet wide and 12 feet deep. It is probable that the Quinnipiac channel will require extension to Lewis's bridge at an early date, but the survey was not carried up so far, and no data as to the depth of water and character of bottom are now available; hence this channel can not be estimated.

The various channels and basins herein described are shown and appropriately marked on the map herewith. These locations are shown, however, only to illustrate the scope of the project and to serve as a basis of estimate. They should not be considered as final, but should be held subject to such changes as future conditions may demand.

The quantities of excavation, corresponding to the several subdivisions of the project, with their cost, at an estimated rate of 10 cents per cubic yard, are as follows:

	Cubic yards.	Cost.
Main channel:		
Across bar	796,000	$79,600
Above bar	1,337,600	133,760
20-foot basin	560,000	56,000
16-foot basin	460,000	46,000
12-foot basin	134,000	13,400
Quinnipiac River, below Grand avenue	266,000	26,600
Mill River to Chapel street	165,000	16,500
Mill River to Grand avenue	107,000	10,700
	3,825,600	382,560
Add for contingencies		17,440
Total estimated cost		400,000

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In my opinion the harbor of New Haven, Conn., is worthy of improvement by the General Government on the plans and to the extent above set forth.

Very respectfully, your obedient servant,

SMITH S. LEACH,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.
(Through the Division Engineer.)

[First indorsement.]

NORTHEAST DIVISION ENGINEER OFFICE,
New York, July 1, 1897.

Respectfully forwarded to the Chief of Engineers.

The local engineer reports the harbor of New Haven worthy of improvement, and submits a project combining two improvements—one covering the district heretofore improved by Government appropriations, extending from the entrance to Tomlinson's Bridge, and the other, an extension of that improvement (with diminished widths and depth) up Mill and Quinnipiac Rivers to Grand avenue, whose waters will soon become available for commerce by the reconstruction or modification of bridges, thereby giving vessels access to higher reaches not previously improved.

The improvement projected from the entrance to Tomlinson's Bridge provides for three interior basins, affording separate anchorages of 20 feet, 16 feet, and 12 feet depths for deep-draft, light-draft, and pleasure vessels, respectively, and all connected by adequate channels. The total cost of the combined improvements is estimated at $400,000.

The large tonnage of the harbor and the great numbers of vessels of all classes which resort to it make the project a reasonable one.

The views of the local officer are concurred in.

G. L. GILLESPIE,
Colonel, Corps of Engineers, Division Engineer.

D 19.

SURVEY OF HOUSATONIC RIVER, CONNECTICUT.

[Printed in House Doc. No. 16, Fifty-fifth Congress, first session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., March 27, 1897.

SIR: I have the honor to submit the accompanying copy of report, dated March 16, 1897, with map,* by Maj. Smith S. Leach, Corps of Engineers, upon a survey of Housatonic River, Connecticut, made in compliance with the provisions of the river and harbor act of June 3, 1896.

This river is now being improved by the United States, the existing project providing for the excavation of material, the construction of a dike and jetty, and the protection of the channel at the mouth by a breakwater, with the view of securing a channel 7 feet deep at mean

*Not reprinted. Printed in House Doc. No. 16, Fifty-fifth Congress, first session.

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low water from Long Island Sound to the head of navigation, a distance of 13 miles, and a width of 200 feet over the bar at the mouth and 100 feet elsewhere.

The plan of improvement now submitted provides as follows:

1. For a channel 100 feet wide and 7 feet deep at mean low water, to be maintained above Stratford by periodic dredging to 8 feet below mean low water.

2. For a channel 100 feet wide and 7 feet deep at mean low water, to be maintained between Stratford and the bar below by extending the training dike sufficiently to fix the trace of the channel and by periodic dredging to 8 feet.

3. For a channel 200 feet wide and 9 feet deep at mean low water, to be maintained across the outer bar by periodic dredging to 10 feet.

In this connection Major Leach states that a contract for dredging now pending, together with dredging by oystermen on the outer bar, will give the project depth and width throughout the river, and that the following estimate of cost of the work contemplated in the plan of improvement herewith submitted is based on the availability of funds in the amounts and at the periods named, beginning in 1898, viz:

Biennial dredging	$4,000
Training-dike extension	15,000
Appropriation needed for fiscal year ending 1898	19,000
Appropriation needed for fiscal year ending 1900 and every alternate year thereafter	4,000

The views of the local officer are concurred in by the division engineer, Col. G. L. Gillespie, Corps of Engineers.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF MAJ. SMITH S. LEACH, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
New London, Conn., March 16, 1897.

GENERAL: I have the honor to submit the following report of a survey of the Housatonic River, provided for in section 9 of the river and harbor act of June 3, 1896, and assigned to my charge in Department letter of September 5, 1896.

The Housatonic having been under improvement for more than twenty-five years, and all the graphic and other information collected during that time being on the files in this office, the field work of the survey was reducible to very moderate proportions, and a comparison of its results with those of previous surveys has much facilitated the preparation of this report. The last survey simply brings the river's history up to date, and this report does no more than analyze that history and judge the nature of the stream from observation of its past.

The field work was done by a small party in charge of Mr. H. B. Gorham, assistant engineer, and occupied the time from October 28 to October 31, 1896. A line of channel soundings disclosed the localities

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where depths less than the project (7 feet) were to be found, and those localities were carefully sounded. The results are exhibited on the accompanying map. The general map of the river is compiled from prior surveys, and beside it, referred to their true positions, are shown on larger scale the areas recently sounded.

The Housatonic River rises in the Hoosac Mountains, in the Berkshire Hills of western Massachusetts, and flows south through Connecticut to Long Island Sound. Its principal tributary, the Naugatuck, joins it from the east at Derby, 13 miles from the mouth. Both these streams flow through valleys comparatively narrow and over beds mainly rocky. Both may be classed as clear-water streams. The Housatonic is dammed just above the junction, and its heavier sediment is settled out. No measurements of discharge have been made, but the combined low-water flow of the two streams may be taken as 1,600 cubic feet per second, or a little more. This approximate quantity is derived from the volume of the fresh-water part of the tidal prism.

The navigable portion of the Housatonic is the stretch of 13 miles below the falls, which are a short distance above the junction of the Naugatuck. The navigation of the river is interrupted by ice from the latter part of December to the early part of March, or, say, two and one-half months in every winter, except those which are unusually mild. In severe winters the interruption is of greater duration. Two drawbridges, one railway and one highway, cross the river near together, and about a mile above Stratford. Each has a clear draw opening of 80 feet.

From the head of navigation to the Washington Bridge, about 9 miles, the river flows between rocky banks 10 to 30 feet high, separated 500 to 2,500 feet. The valley so formed is fairly regular in width and curvature. At the wider places the river has formed a scanty alluvial plain having its surface 2 to 4 feet above ordinary high water. This plain is overflowed by a combination of extreme freshets and high tides. The highest freshet of which information is available—that of February, 1888—reached about 10 feet above average high tide at Derby.

The channel of the river, as distinguished from the valley, is 500 to 1,200 feet in width. The two are coincident in the main, and the channel is against the rocky bank on one side or both through more than nine-tenths of its developed length. For this reason the channel in its natural condition has a fixed trace, which is that characteristic of alluvial streams. Except as modified by accidents of the unyielding shore, the thalweg follows the concave side of each bend and then crosses obliquely to the other bank. At these crossings the shoal water is found, and as the stream is narrow the bars are short, and a cut from one pool to the next involves a comparatively small volume of material.

In the regimen of the stream tidal conditions predominate. The water is always and wholly fresh for 4 miles below the head of navigation. For some 2 miles farther the surface water is fresh and that near the bottom brackish. A noticeable upstream current at flood tide has been observed as far up as Drews Bar, 4 miles below the head. The influences at work in the channel are doubtless a pulsating current at the upper end and an alternating current below. The neutral ground separating the pulsating from the alternating flow is in the vicinity of Drews Bar, 4 miles below Derby, or 9 miles from the mouth. This should be the locus of greatest fluvial deposits, and it doubtless is so, for Drews Bar has given the most trouble in the past, and is, as shown

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by the survey, the shoalest to day, having but 4½ feet at mean low water, which is more than a foot less than Mill Bar, the next shoalest, and 20 inches less than any of the other bars examined.

A short distance above Stratford the valley widens out and the river merges into a small estuary. The channel follows the right or west bank, and the river flows in a bed of normal dimensions between that bank and a low island, to a point about half a mile below the village of Stratford. Here the natural fixity of trace ends, and from here to the mouth of the estuary, a distance of a mile, the shifting of the trace is the controlling feature of the regimen. The problem of carrying the navigable depth across the sea bar is distinct from each of the others, so that this stretch of river, short as it is, must be treated in three separate parts—the stable river, the unstable river, and the sea bar.

In the first of these parts, referred to as stable, the conditions naturally prevailing are substantially those of a regulated river. The alluvial plain is of a gravelly character and erodes but slowly. The bar-forming material is almost wholly derived from the streams above the junction, and since the construction of the dam in the Housatonic this material is but little in excess of that supplied by the Naugatuck. The water at ordinary river stages is so nearly clear that a diver working 4 feet under the surface has been plainly seen. But one change in the channel is on record, which occurred at Mill Bar about the time the first survey was made, twenty-five years ago, the river leaving the chute between Long Island and Popes Flat and taking its present course. The trace is fixed and favorable to the maintenance of depth, and the supply of bar-forming material is small. A comparison with former surveys indicates that the total deposit above Stratford in a channel 7 feet deep at mean low water and 100 feet wide will not exceed 7,000 cubic yards per annum. The deposits in an 8-foot channel would be somewhat greater, of course, possibly reaching 9,000 cubic yards per annum. This comparison is based on a period during which no material was taken out of the river, but all dredgings were deposited behind islands and other places, whence a part undoubtedly got back into the channel. For this part of the river the method of improvement is obvious, and consists in determining the size of the channel justified by commercial considerations and then maintaining such a channel by periodical dredging.

The part of the river from half a mile above Stratford to the bar is that mentioned above as unstable. The upper part of this reach shows no change of trace within the recorded history of the stream, and none will probably occur, on account of the permanent conditions immediately above. There is a tradition, however, that the entire river once went to the east of Nells Island. At the bend below Stratford the natural conditions permit an actual shifting of the trace to the extent of sudden and bodily displacement, an existing channel being abandoned for a new one. All the dredging done at this point, which has averaged 2,000 cubic yards per annum for some years past, has been for the creation of channels, now on one line and now on another. Dredging for what might properly be called maintenance has never been done here, and there is no basis of estimating its amount, except that it can not well be as much as the frequent opening of new channels has required.

The necessity for fixation of channel at this point has not escaped attention, and a beginning has been made in the construction for a short dike projecting obliquely from the shore below Stratford. This dike was begun tentatively on a project adopted in 1893, which did not specify its ultimate length. At its present length, 555 feet, it terminated on the edge of the channel in use at that time, and to have pushed

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it further would have blocked that channel, with only a precarious chance of opening another. It is held in view in the latest reports as an object of future expenditure. If a channel were opened on the desired line by dredging, the dike could be rapidly extended and the result would probably be to fix the trace sufficiently to make feasible its maintenance by periodical dredging of moderate quantities of material. With a fixed trace, the dredging for maintenance of a 7-foot channel may be conservatively placed at 1,500 cubic yards per annum.

The sea bar is a typical one, and a single opinion of its proper treatment has been held by all the engineers who have considered the question. The littoral drift here is from the east, and the necessity of interrupting it by a breakwater on the east side of the proposed channel is obvious. A practical demonstration of this necessity (if such were needed) is found in the fact that a channel 70 feet wide and 9 feet deep dredged across the bar in 1886 by certain oyster growers, who desired to use the material for hardening their ground, had its outer portion completely filled with sand by the first severe storm.

The breakwater was begun in 1888 and finished, though with reduced section, in 1895. Its position is shown on the map. Near its inner end, at the crossing of Bull Run Channel, it has settled, and, although rebuilt three times, is now so far below grade as to permit at low tide a considerable flow of water across it at that point. Since the breakwater has been in place the bar has been dredged to form a channel 100 feet wide and 9 feet deep. No perceptible shoaling has occurred in this dredged area, and it may be accepted as certain that a channel of requisite dimensions can be maintained across the bar without excessive cost.

The measure of improvement to be attempted is less readily discernible than the method of obtaining it. In 1871, when the first project was formed, the river was a very different factor in the local transportation problem from what it is to-day, though its importance has perhaps not lessened in the transition. At that time it was the only avenue of cheap carriage for a large and flourishing manufacturing and agricultural district. Had it remained so, there would be no question of the propriety of developing in it the largest possible channel. Now, however, this same district is mainly supplied by railways, which carry freight of most kinds at rates which vessels find closely competitive. It is doubtless true that these low rates never would have been reached but for the improvement of the river, and that they would not be maintained were the improvement abandoned. In addition to this potential usefulness, the records of 1893, the last received, show a traffic of 160,000 tons per annum, 75 per cent of which, it is estimated, traversed the whole river, while the remainder went as far as Stratford. This freight is carried in steam canal boats and in barges and sailing vessels towed by tugs. With the exception of the oyster fleet, which frequents the lower part, the river is little used by sailing vessels.

Such was not the case formerly, and in the early history of the improvement of the river importance was given to the necessity of a greater relative depth on the upper bars in order that sailing vessels crossing the outer bar at high tide and running less rapidly than the crest of the wave might find enough depth all the way up. Such necessity no longer exists, and the channel may now properly be adjusted to the wants of steam vessels which can move upstream at the same velocity as the wave and thus have the full benefit of the tide at every point. The rise of tide varies not more than six-tenths of a footfrom Stratford to Derby, and a channel of uniform depth at low water will present substantially the same condition at high water. A depth of 9

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feet, or 2 feet more than in the river channel, is now maintained across the outer bar on account of the greater difficulties of navigation in partially exposed waters. The projected width of this channel is 200 feet, for the same reason. These features should be repeated in any project adopted.

The currents in the river, though not excessive in rate of motion, are greatly dreaded by pilots, and are sufficient when at or near their strength, to invest the navigation of a narrow artificial channel with much difficulty and some risk. At high water the leeway is greater and the current moderate, and for freight vessels, with deep draft and little excess of power, the advantage of these conditions outweighs the inconvenience of a few hours delay. An artificial channel of dimensions to permit easy navigation at low stages is wholly incommensurate with the importance of the river, and hence it should seem that the freight traffic of the Housatonic will necessarily be a high-water navigation. The present project of 7 feet below mean low water affords a high-water depth of over 11 feet, which is believed to be sufficient, as it is in excess of the maximum draft of vessels now seeking the trade. This is also about the minimum depth in the pools, so that vessels drawing all the water on the shoals can find safe berths in case of accident or detention, with sufficient depth to prevent grounding at low water.

For passenger traffic, mails, express, and perishable freight, a regular schedule is of paramount importance, and such boats must be able to use the channel at any stage of water. It is also true that a continuous service is desirable, and this in the Housatonic is impossible on account of interruption of navigation by ice. The fact that there is no passenger vessel plying in the river may be referred quite as fairly to the ice as to deficient depth, and it is not probable that greater depth would result in the establishment of any passenger lines. For the class of vessels likely to engage in an intermittent service the depth of channel now projected will suffice.

The foregoing arguments and conclusions may be summarized as follows:

The Housatonic is, in its natural condition, a stream with practically regulated trace, a fairly stable bottom, and a limited supply of suspended sediment. From these conditions theory would predict and observation confirms a decided tendency to persistence in cuts dredged across the bars and on or near the natural thalweg.

A channel 100 feet wide and 7 feet deep at mean low water can be secured from the head of navigation to Long Island Sound by the maintenance of the present breakwater and by periodical dredging, all at a cost justified by the usefulness of the stream.

In the bend below Stratford such a channel can be kept open with greater certainty and at less cost by extending the training dike and dredging in reduced amount.

The following project and estimate of cost is submitted:

A channel 100 feet wide and 7 feet deep at mean low water to be maintained above Stratford by periodical dredging to 8 feet below mean low water.

A channel of the same dimensions to be maintained between Stratford and the bar by extending the training dike sufficiently to fix the trace and supplementing its effect by periodical dredging to 8 feet.

A channel 200 feet wide and 9 feet deep at mean low water to be maintained across the outer bar by periodical dredging to 10 feet.

From all data obtainable it is estimated that the whole amount of dredging will not exceed 10,000 cubic yards per annum, or assuming

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that the most convenient interval will be two years, a quantity not exceeding 20,000 cubic yards will require removal every second year.

The training dike will run in water averaging 6 feet deep at low water and should rise to mid tide, making its average height 9 feet. With suitable slopes and crown it will contain about 5 cubic yards to the running foot, and will probably cost about $10 a foot. The total length required will not be less than 1,500 feet. It should be built rapidly, and hence should not be undertaken unless funds are available to complete it.

The breakwater calls for no definite expenditure. The completion of a contract now pending will leave it in satisfactory condition. The original projected cross section has not been attained, it is true, but experience indicates that the present section is enough, and if so, no increase is desirable. The gap at Bull Run Channel need not be closed. The function of the structure is not so much to concentrate flow across the bar as to intercept the littoral sands, and the latter effect is not reduced by the gap.

A contract for dredging, now pending, together with dredging by oystermen on the outer bar, will give the project depth and width throughout the river, and the following estimate is based on the availability of funds in the amounts and at the periods named, beginning in 1898:

ESTIMATE.

Biennial dredging, 20,000 cubic yards, at 20 cents	$4,000
Training dike, 1,500 feet, at $10	15,000
Appropriation needed for fiscal year 1898	19,000
Appropriation needed for fiscal year 1900 and every alternate year thereafter.	4,000

In my opinion the Housatonic River is worthy of improvement as above projected and estimated.

Very respectfully, your obedient servant,

SMITH S. LEACH,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.
(Through the Division Engineer.)

[First indorsement.]

NORTHEAST DIVISION ENGINEER OFFICE,
New York, March 20, 1897.

Respectfully forwarded to the Chief of Engineers.

This is a carefully prepared paper and the conclusions reached are logical.

The local engineer submits project and estimate for (1) a channel 100 feet wide and 8 feet deep from head of navigation to Stratford, opened and maintained by dredging; (2) a channel of same dimensions from Stratford to the mouth, opened by dredging and maintained by training-dike extension and dredging; and (3) a channel across the bar 200 feet wide and 10 feet deep, maintained by dredging, the breakwater being kept in repair.

The estimated first cost of constructing dike is $15,000 and the annual maintenance at $4,000 up to 1898, after which date the estimated annual maintenance is $2,000.

The views of the local officer are concurred in.

G. L. GILLESPIE,
Colonel, Corps of Engineers, Division Engineer.

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D 20.

SURVEY OF SOUTHPORT HARBOR, CONNECTICUT.

[Printed in House Doc. No. 112, Fifty-fourth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 14, 1896.

SIR: I have the honor to submit the accompanying copy of report of December 7, 1896, by Capt. Smith S. Leach, Corps of Engineers, of the results of a survey of Southport Harbor, Connecticut, made to comply with the provisions of the river and harbor act of June 3, 1896.

In 1878 a project was adopted for the improvement of this harbor, and provided for dredging a channel 100 feet wide and 4 feet deep at mean low water across the bar and upstream to White Rock; thence two channels of less width to the nearest docks.

Captain Leach is of the opinion that a channel of the same width as that of the last project, but extended a little farther upstream and 6 feet deep at mean low water, will probably meet all present and reasonable demands. To provide such a channel and repair existing damage to breakwater he estimates will cost, including supervision and administration, $12,700. To maintain the proposed channel depth will cost $300 per annum.

Very respectfully, your obedient servant,

W. P. CRAIGHILL,
Brig. Gen., Chief of Engineers.

Hon. DANIEL S. LAMONT,
Secretary of War.

REPORT OF CAPT. SMITH S. LEACH, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
New London, Conn., December 7, 1896.

GENERAL: Pursuant to instructions contained in Department letter of September 5, 1896. I have the honor to inform you that a survey of Southport Harbor has been made and to submit the accompanying map* of the same and the following report thereon:

The harbor of Southport is formed by the lower part of Mill River, a small stream flowing into Long Island Sound, about 6 miles west of Bridgeport. The part of Mill River used by commerce is below Mill Bridge, and is about 1 mile in length. The width of the stream averages less than 100 yards. The west bank is bold and permanent. The east bank is the edge of a large area of marshy land. The mean tidal oscillation is 6.6 feet.

This harbor was one of the early improvements undertaken on the north shore of Long Island Sound. Beginning with an appropriation of $6,097 on March 2, 1829, work was prosecuted until 1838, when a permanent dike and breakwater pier had been built and the channels scraped out to afford a depth of 2 feet at mean low water. The total appropriations to this date were $13,087 43.

In 1870 an examination and report were ordered, and as a result further work was recommended. Appropriations in 1875 and 1876 were

* Not printed.

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expended in raising, repairing, and strengthening the dike and pier, and in dredging a channel 60 feet wide and 4 feet deep across the bar. In 1878 a project was adopted for a dredged channel 100 feet wide and 4 feet deep at mean low water across the bar and up the stream to White Rock, 1,200 feet from the outer end of the pier, and thence in a bifurcated channel to the nearest docks. In 1882, when appropriations aggregating from the beginning, in 1829, $31,587.43 had been made, this project was reported as substantially completed, the deficiencies being in the widths in the upper part, which were less than 100 feet. In 1885 it was reported that the channel showed no material change. No work has been done since 1883.

The present survey was made October 26 to 28, 1896, by a party in charge of Assistant H. B. Gorham. The map, which is transmitted herewith, shows that the dredged channel across the bar has shoaled somewhat, presenting depths of about 3½ feet at mean low water. From the outer end of the pier to White Rock (1,200 feet) the present depths are generally greater than those which the reports indicate to have been left by the dredge, averaging something over 5 feet. Abreast of White Rock a shoal appears to have formed, and in the upper part of the dredged channels decided shoaling appears to have taken place. The net result of a comparison of this last with previous surveys is to indicate a very satisfactory permanency of channel dimensions and to encourage the belief that an artificial channel not greatly exceeding the present maximum of depth may be easily kept open. The commerce of the harbor during the last year, as reported by Mr. R. P. Curtis, chairman of the harbor committee, is as follows:

The shipments from the port from December 1, 1895, to December 1, 1896, were 8,665 tons of farm produce. The receipts during the same period aggregated 16,480 tons and consisted of coal, grain, fertilizers, and building materials. There are three lines of schooners, employing five vessels and making weekly trips between Southport and New York. There is also a considerable fleet of oyster boats working on neighboring beds which use the harbor as a night berth and storm haven.

A channel of the same width as that of the last project, but extended a little farther upstream and 6 feet deep at mean low water, will probably meet all present and reasonable demands. To make such a channel, which is indicated on the map, will require about 75,000 cubic yards of dredging, which is estimated to cost, including supervision and administration, $12,500. The lower part of such a channel will probably not shoal fast enough to make an estimate for maintenance expedient. The upper part, about 1,000 feet long, appears to be the locus of fluvial deposits and will probably shoal so rapidly as to require biennial dredging to maintain the project depth. Such dredging will involve about 5,000 cubic yards of material, costing about $600 every other year.

During the last gale, which occurred since the field work of the survey was completed, a gap was made in the coping of the breakwater at or near the point indicated on the map. It is imperatively necessary that this be repaired at an early date, to prevent the destruction of a part of the pier. It will cost $200, making the total cost of the project $12,700. This sum can be advantageously expended in one year. To maintain the improvement will cost $300 per annum, to be expended biennially.

Comparing this cost with the value of present and prospective commerce, as herein reported, I am of the opinion that Southport Harbor

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is worthy of improvement by the General Government, to the extent of the excavation and maintenance of the channel herein proposed.

Southport Harbor is in the collection district of Fairfield, Conn. The nearest light is Penfield Reef, 3¼ miles distant, east of the harbor. The nearest work of defense is Fort Hale, New Haven Harbor, distant 24 miles.

Respectfully submitted.

SMITH S. LEACH,
Captain, Corps of Engineers.

Brig. Gen. W. P. CRAIGHILL,
Chief of Engineers, U. S. A.
(Through the Division Engineer.)

[First indorsement.]

NORTHEAST DIVISION ENGINEER OFFICE,
Washington, December 9, 1896.

Respectfully forwarded to the Chief of Engineers concurring in the views and recommendations of the local engineer.

JOHN M. WILSON,
Colonel, Corps of Engineers, Division Engineer, N. E. Division.

D 21.

MODIFICATION OF HARBOR LINES AT BRIDGEPORT, CONNECTICUT.

The SECRETARY OF WAR:

The undersigned respectfully represent that they are the owners of certain uplands, bounded westerly on the channel of the harbor of Bridgeport, Conn., and that as such they are entitled to all the rights and privileges pertaining to said ownership.

That heretofore, to wit, on the ——— day of ———, ———, there was established by your honorable predecessor in office a harbor line on the east side of the harbor of Bridgeport, the effect of which has been to interfere with the rights of the littoral proprietors in that it has prevented them from docking out to navigable waters without gaining any advantage to the public generally, which it was undoubtedly hoped and expected would be accomplished by the establishment of such line; that said line passes over mud flats removed at least 60 feet from the navigable waters of the harbor of Bridgeport, running substantially parallel therewith and above the low-water mark, so that at a considerable period of each day a strip of land lies bare between said established harbor line and the navigable waters of said harbor.

That the Government has never deepened the waters of said harbor up to said line, so that ever since the establishment thereof it has been and still is impossible for your petitioners to exercise the right of wharfing out to the navigable waters of said harbor.

Said harbor line was established without in any way compensating your petitioners, or those to whose rights and titles they succeeded, or giving them any opportunity to be heard regarding the value of the same, or the damage to them by reason of the taking away of such rights; that a solid stone pier or bridge has been built across said harbor by the city of Bridgeport in such a way that if there ever was any advantage in having the tides ebb and flow so as to clear said harbor from mud, silt, and other substances said pier has interfered with

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that object as much as the erection of any wharf or pier over the property of your petitioners could possibly interfere with the same.

That as all of said flats are above low-water mark, they can not be occupied by even the smallest boats, except at high water, and are of practically no use to the public generally; that there is no commerce between the city of Bridgeport, in the State of Connecticut, and any other State or foreign country that can be interfered with by the change of said harbor line; that in the opinion of your petitioners, and such authorities as they have been able to consult upon the subject, the removal of said harbor line and the establishment of a new line some —— feet west of and running substantially parallel with the line established, as hereinbefore set forth, would in nowise interfere with the navigation of said harbor, but would, on the contrary, afford an opportunity to build docks on the east side of the harbor, which would facilitate the navigation and commerce of said port.

That there are many reasons why the prayer of these petitioners should be granted aside from those herein contained, growing out of the manner in which said harbor line was originally established, but which, as they do not affect the question immediately involved, and as most of them are of record in the office of the Secretary of War, they are not embodied herein, but reference is made to said records and to the statements concerning the same, hereto annexed and marked Exhibit A.*

And, as in duty bound, your petitioners will ever pray.

Dated at Bridgeport, this —— day of June, 1897.

HARRIET J. NOBLE,
CLARENCE M. NOBLE,
HENRIETTA M. NOBLE,
JOHN F. NOBLE,
By SEYMOUR & KNAPP,
Their attorneys, Bridgeport, Conn.

[Second indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
June 17, 1897.

Respectfully referred to Maj. Smith S. Leach, Corps of Engineers.

The Secretary of War directs that the usual public hearing shall be held, investigation made, and report and recommendation submitted.

The previous papers are herewith.*

By command of Brig. Gen. Wilson:

A. MACKENZIE,
Lieut. Col., Corps of Engineers.

[Third indorsement.]

U. S. ENGINEER OFFICE,
New London, Conn., August 3, 1897.

Respectfully returned to the Chief of Engineers, inviting attention to the report and recommendation forwarded herewith.

The parties in interest have received due notice and have had reasonable opportunity to be heard, as required by law, as will appear from the abstract* of public hearing also transmitted herewith.

SMITH S. LEACH,
Major, Corps of Engineers.

(Through the Division Engineer.)

* Not printed.

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[Fourth indorsement.]

NORTHEAST DIVISION, ENGINEER OFFICE,
New York, August 19, 1897.

Respectfully returned to the Chief of Engineers recommended for approval.

The changes from the line approved by the Secretary of War July 1, 1893, are very slight and will, if adopted as recommended by the district officer, only slightly reduce the space available for the anchorage of vessels, and then only after the shoal areas close to the causeway shall have been dredged out.

G. L. GILLESPIE,
Colonel, Corps of Engineers, Division Engineer, N. E. Division.

[Fifth indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
August 24, 1897.

Respectfully returned to the Secretary of War.

This is an application for a change in the established harbor lines at Bridgeport Harbor, Connecticut.

By direction of the Secretary of War a public hearing has been accorded the parties interested, and after careful consideration of the present conditions, Maj. S. S. Leach, Corps of Engineers, in report of the 3d instant, recommends that the lines be changed as shown on the accompanying map.* The description of the lines in the vicinity with the proposed modifications will read as follows:

The line extending southward from the foot of Howe street to be prolonged to an intersection with the line lying in the face of the abutment of the causeway, and prolonged northward; thence to follow the last-described line and its prolongation southward to a point 100 feet south of the south line of the causeway; thence to follow a line parallel to the causeway and 100 feet distant from the south line, to an intersection with a line drawn from a point on the south side of the causeway 200 feet from its western end, to a point on the harbor line of 1886, 340 feet north of the Farist Steel Company's wharf; from this intersection, along the line just described, to its intersection with the line of 1886; thence along that line to Long Island Sound.

From the point on the above-described line 100 feet north of the north line of the causeway a pierhead line shall extend parallel to the bridge, and 100 feet distant from the north side thereof, for a length of 165 feet; thence on a straight line to the northeast corner of the east abutment pier of the draw. The line south of and parallel to the causeway shall be prolonged westward as a pierhead line for a distance of 175 feet; thence on a straight line to the southeast corner of the east abutment pier of the draw.

Between the two pierhead lines the first-described line shall be a bulkhead line, elsewhere it shall be a pier and bulk head line.

Col. G. L. Gillespie, Corps of Engineers, the division engineer, states, in fourth indorsement hereon, that the changes from the established lines are very slight and will, if adopted, only slightly reduce the space available for the anchorage of vessels, and then only after the shoal areas close to the causeway shall have been dredged out.

The existing harbor lines at Bridgeport were established after the subject had received careful investigation and consideration by a Board of Engineers. At the time of their adoption they were considered necessary for the preservation and protection of the harbor and the commercial interests thereof, and though a number of applications have been made for modifications they have been uniformly denied by the Secretary of War.

*Not printed.

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Inasmuch, however, as the conditions of the harbor have changed somewhat since the harbor lines were originally established, in July, 1893, and there appears to be less need for anchorage space at the point in question than there was at that time, I am of the opinion that the slight changes recommended by the district officer may be made without detriment to the harbor interests.

I therefore recommend that the modified lines described in this indorsement and shown on the map be approved, and that the Secretary place his approval both upon the tracing and upon this paper.

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. A.

[Sixth indorsement.]

WAR DEPARTMENT, *August 26, 1897.*

Approved as recommended by the Chief of Engineers.

G. D. MEIKLEJOHN,
Acting Secretary of War.

REPORT OF MAJ. SMITH S. LEACH, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
New London, Conn., August 3, 1897.

GENERAL: Referring to second indorsement on $\frac{1005}{20}$, I have the honor to submit the following report and recommendation in the matter of the petition of Clarence M. Noble and others for certain changes in the harbor lines of the harbor of Bridgeport, Conn.:

Careful consideration of the previous papers in the case, also referred to me by the indorsement above cited, discloses the following facts:

In 1891 the subject of harbor lines at Bridgeport was considered by a Board of Engineers, of three members. A previous controversy over the proposed establishment of such lines by the city of Bridgeport, under a State law, gave the matter increased prominence and importance; but the details of that controversy are no longer pertinent.

During its investigation, the Board of Engineers held a public hearing in the city of Bridgeport, at which all the parties known to be in interest were represented. At the hearing and at other times, the city officials of Bridgeport and the Board of Trade of that city urged upon the Board of Engineers the absolute necessity, for anchorage purposes, of the space immediately adjoining the causeway on the east end of Stratford Avenue Bridge and the eastern part of the bridge itself, and demanded that the harbor lines be made coincident with the north, west, and south limits of the causeway. These arguments and a personal examination of the locality convinced the Board of Engineers that the harbor lines should be run as requested, and they so reported.

A protest was presented by counsel for the riparian proprietor; but it took the form of a legal argument, assailing the right of the United States to establish harbor lines under the law of September 19, 1890, and of the Secretary of War to establish such lines in this particular case. These arguments the Board of Engineers did not feel competent to express an opinion upon, and for that reason forwarded, without comment, the brief and related papers. It does not appear that a plain statement of the equities in the case was presented by the riparian owners for the information of the Board of Engineers.

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The report of the Board, after reaching the Secretary of War, remained unacted upon until July 1, 1893, when the Assistant Secretary of War took the matter up, and approved the lines recommended by the Board.

Since the establishment of the harbor lines, applications have been made by and in behalf of parties who had purchased from the former proprietor for permission to extend piers beyond the harbor lines. These applications have been denied; and the reason most strongly urged against them has been the inequity and apparent bad faith on the part of the United States in taking a valuable right from the original owner and restoring it to those who had purchased from him, presumably at a price influenced by the harbor-line restrictions.

It is not easy to see how the Board of Engineers could have arrived at a different conclusion on the merits of the case as presented to them; and it is clear that the applications above referred to could not have been granted without manifest injustice. Should the present petition be favorably considered, it must be because of important changes in the conditions of the case. It is to be noted, in the first place, that this petition differs from the previous applications in that the petitioners are the direct heirs and legal representatives of the proprietor from whom the rights were taken, and any privileges restored to them are in equity restored to him.

The establishment of lines along the north, west, and south limits of the causeway appears to have worked unusual hardship upon the riparian proprietor. By drawing the lines at the margin of the causeway, the corresponding riparian rights were totally extinguished, as well as those on both sides of the bridge. There was not a foot of ground left in full control of the owner to which betterments could attach, and so recoup him in part for the value of that taken away. True, the fee simple remains in the proprietor; but it is an empty title, because the harbor-line restrictions make every possible usufruct of the property valueless. If estimates herewith submitted may be relied upon, the property so taken has a value of $100 per front foot, measured on the bridge and causeway, representing the sequestration of about $60,000 worth of private property for public uses, without compensation. It needs no argument to show that such sequestration can be justified only when the public interests are of the plainest and most imperative character. At the public hearing, held as directed in the indorsement cited, every effort was made to elicit information on this point, but, generally speaking, without success. The representatives of the opposing interests were informed that concrete facts were especially desired as to the necessity for more harbor room in the vicinity of the causeway, and they were told that, as their interests represented the affirmative side of the proposition, they would be held responsible for the production of proof to sustain their position. No such testimony was offered. It was not shown that any accident had ever occurred in that part of the harbor due to lack of space. It was not shown that any vessels desiring to anchor there had ever found it impossible or inconvenient to do so. It was not shown that it is necessary for any vessels to anchor in this part of the harbor. It is frequented by oystermen, but it is not the place of discharge for their cargoes, and there appears no reason for their going there more cogent than the personal convenience of the crews. There is ample anchorage space for them below the Naugatuck Dock, convenient to their discharging piers, and sheltered by a breakwater. Captain Lewis, the president of the State Oystermen's Association, testified at the hearing that small ves-

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sels are compelled to use the upper anchorage because the lower one is not safe. This was disputed by Captain McNeil, the harbor master now and for many years past, who says the lower anchorage is perfectly sheltered by the breakwater. The latter view seems more probable. The construction of the breakwater had just begun when the Board of Engineers held its hearing, and it is doubtless true that its effect was not taken into consideration by the interests which then demanded more room above.

A circumstance entirely unconnected with the interests of the petitioners seems to demand that the harbor lines be removed some distance from the south line of the causeway. From testimony given by the city engineer of Bridgeport at the last hearing, it appears that the causeway was originally built 25 feet wide and that the original structure is the north half of the present one. That half is on a foundation supposed to be timber cribs, but its character is not certainly known. The south half, subsequently built, rests on a foundation of piles and grillage. The piles were driven to about 40 feet in mud, giving satisfactory bearing power, but no great lateral stability. To dredge up to the side of the causeway, as contemplated in the present project (House Doc. No. 61, Fifty-fourth Congress, first session), would undoubtedly jeopardize the foundation of the causeway. How near such dredging can be safely carried can not be determined absolutely, but, in my opinion, not nearer than 50 feet.

Another independent consideration demanding a change in the harbor line along the south side of the causeway arises from a point made at the hearing by Mr. Farist, of the Farist Steel Company, that the causeway is now too narrow for its traffic, and that it must sooner or later be widened. It would complicate the problem of widening if a change in the harbor lines were involved.

To summarize the foregoing, it is my opinion that no objection has been shown to restoring the riparian rights on the north side of the bridge; that no reason has been shown why the present harbor line along the west margin of the causeway should be changed in any respect; that, while it may be desirable to have more anchorage space adjacent to the south side of the bridge and causeway, a necessity for such room has not been shown to exist or to be likely to arise in the future of the paramount nature which would justify the entire sequestration of riparian rights of more than ordinary value, and that the restoration of full riparian rights along the south side of the bridge and causeway would effect a more equitable adjustment of public and private interests than now exists, and would offer the incidental advantages of protecting the foundation of the causeway from undermining and of giving room to widen the structure without a further disturbance of the harbor lines.

I have, therefore, the honor to recommend that the harbor lines in the vicinity of the causeway be changed so as to occupy the positions and possess the characteristics—as to pierhead and bulkhead lines—shown on the accompanying sketch.* I also recommend that the official description of these lines, as given in the third paragraph on page 1001 of the Report of the Chief of Engineers for 1893, be amended to read as follows:

The line extending southward from the foot of Howe street, to be prolonged to an intersection with the line lying in the face of the abutment of the causeway, and prolonged northward; thence to follow the last-described line and its prolongation

* Not printed.

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southward to a point 100 feet south of the south line of the causeway; thence to follow a line parallel to the causeway and 100 feet distant from its south line to an intersection with a line drawn from a point on the south side of the causeway, 200 feet from its western end, to a point on the harbor line of 1886, 340 feet north of the Farist Steel Company's wharf; from this intersection, along the line just described, to its intersection with the line of 1886; thence along that line to Long Island Sound.

From the point on the above-described line 100 feet north of the north line of the causeway a pierhead line shall extend parallel to the bridge, and 100 feet distant from the north side thereof for a length of 165 feet; thence on a straight line to the northeast corner in the east abutment pier of the draw. The line south of, and parallel to, the causeway shall be prolonged westward as a pierhead line for a distance of 175 feet; thence on a straight line to the southeast corner of the east abutment pier of the draw.

Between the two pierhead lines the first-described line shall be a bulkhead line; elsewhere it shall be a pierhead and bulkhead line.

In connection with this report, attention is respectfully invited to the abstract* of the public hearing and a sketch* of the upper part of Bridgeport Harbor, which are forwarded as additional inclosures to the indorsement calling for this report.

Very respectfully, your obedient servant,

SMITH S. LEACH,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

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APPENDIX E.

IMPROVEMENT OF NEW YORK, PEEKSKILL, RONDOUT, AND SAUGERTIES HARBORS, AND OF HUDSON, HARLEM, AND EAST RIVERS, NEW YORK.

REPORT FOR THE FISCAL YEAR ENDING JUNE 30, 1897, WITH OTHER DOCUMENTS RELATING TO THE WORKS. OFFICERS IN CHARGE, COL. G. L. GILLESPIE AND LIEUT. COL. WILLIAM LUDLOW, CORPS OF ENGINEERS.

IMPROVEMENTS.

1. Hudson River, New York.
2. Saugerties Harbor, New York.
3. Rondout Harbor, New York.
4. Peekskill Harbor, New York.
5. Harlem River, New York.
6. East River and Hell Gate, New York.
7. New York Harbor, New York.
8. Removing sunken vessels or craft obstructing or endangering navigation.

EXAMINATIONS.

9. Catskill Creek, New York.
10. Nyack Harbor, New York.
11. Wallabout Channel, New York.
12. Coney Island Channel, New York.
13. Coney Island Creek, New York.

SURVEY.

14. New York Harbor, New York, from the Narrows to the sea.

HARBOR LINES.

15. Hudson River, from West Twenty-third street to West Eighty-first street, New York City.
16. Hudson River, from Battery Place to West Twenty-third street, New York City, and from Morris Canal Basin to Bulls Ferry, New Jersey.
17. Ellis Island, New York Harbor.
18. Harlem River and Spuyten Duyvil Creek, New York City.
19. East River, near foot of East Eighty-ninth street, New York City.

ENGINEER OFFICE, UNITED STATES ARMY,
New York, July 19, 1897.

GENERAL: I have the honor to transmit herewith annual reports in duplicate, for the fiscal year ending June 30, 1897, upon the works of river and harbor improvement in my charge.

These works were in charge of Col. G. L. Gillespie, Corps of Engineers, until February 23, 1897, with the exception of improvements at Saugerties and Rondout harbors, which were in charge of Maj. H. M. Adams, Corps of Engineers, until March 31, 1897.

Your obedient servant,

WILLIAM LUDLOW,
Lieut. Col., Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

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E 1.

IMPROVEMENT OF HUDSON RIVER, NEW YORK.

The Annual Report of the Chief of Engineers for 1885, Part I, page 677 et seq., contains a history of this work, accompanied by original reports and two sketches, showing its condition at that time.

Prior to 1892 the part of the Hudson under improvement by the General Government was a stretch of about 20 miles, from the head of navigation, at Troy, about 6 miles above Albany, to New Baltimore, about 14 miles below.

This upper section of the river has always been obstructed by bars and shoals, due to the existence of numerous islands and sloughs and the consequent diversion of the river's waters through too many channels.

Prior to 1831 the method followed, consisting chiefly of dredging and the construction of a few spur dikes, had produced little permanent effect.

In 1831 the General Government, rejecting the spur construction, began the present general system of improvement, consisting of channel contraction by the use of longitudinal dikes, assisted when necessary by dredging.

This system was adopted the same year by the State authorities, and from that date to 1890 the improvement was conducted jointly by the State and the General Government, though without any specific mutual agreement.

Under this system the United States constructed two dikes in 1835, 1836, 1837, and 1838. Then followed a long interval in which nothing was done by the United States, except in 1852; but in 1863 the State of New York took up the improvement on the general plan adopted by the United States in 1831, viz, substituting a system of longitudinal dikes for the jetty system, and between 1863 and 1867 built six important longitudinal dikes of this kind. (Annual Report of 1885, p. 678.)

The work was again taken up by the United States in 1864, when out of the general sum appropriated for river and harbor improvements $33,000 was allotted to the Hudson River.

The project adopted in 1867 provided for securing a navigable channel 11 feet deep at mean low water from New Baltimore to Albany, and 9 feet from Albany to Troy.

The adopted plan covered the following measures:

First. A system of longitudinal dikes to contract the width sufficiently to allow the ebb and flow of the tidal currents to keep the channel clear; these dikes to be gradually brought nearer together from New Baltimore toward Troy, so as to assist the entrance of the flood current and increase its height, their height to be kept approximately at the level of the tidal high water, so as not to confine the freshets, the exact level, however, being left to be determined by experience as the work progressed.

Second. The use of dredges, so far as necessary, to open the channels above described, which the currents were not to be allowed to do, except very gradually, lest accumulations dangerous to navigation should be formed below.

Third. The construction of side reservoirs open to the passage of

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tidal currents by gaps at their lower extremities, in order to increase the tidal flow.

Fourth. The dumping of all dredged material in retired places, whence it could not be moved back again into the channel by the currents.

Fifth. The construction of timber and stone dikes to secure permanency at a minimum cost, the details varying with the locality, to be left to the discretion of the local engineer, and the dikes to be so designed as to admit of an increased height when demanded by local necessities.

Sixth. The banks and islands to be protected against the abrading action of the currents by revetments.

Seventh. That limits, beyond which no encroachments upon the channel should be made, be prescribed and enforced.

The cost of the improvement, according to the estimate of 1867, was to be $1,000,000, but the amount which had been actually spent upon the project up to June 30, 1892, the date of its practical completion, was $1,247,940.29.

From the nature of the materials which enter into the construction of the dikes, and from the limited sums available to renew the parts which become unserviceable, whether by natural decay or otherwise, estimates prepared from time to time for the completion of the project must be accepted as accurate for a limited period only, and renewals are not included.

A revised project, adopted in 1891, provided for maintaining the old and constructing new regulating works along 8 additional miles of the river below New Baltimore, and also deepening the entire reach of the river under improvement, so as to make a channel 400 feet wide and 12 feet deep at mean low water from Coxsackie to the foot of Broadway, Troy, N. Y., and thence 300 feet wide and 12 feet deep to the State Dam.

The estimated cost of the project was $2,447,906.56, provided the entire work be completed within five years.

Congress authorized this project by the river and harbor act approved July 13, 1892, with the proviso that contracts might be made by the Secretary of War for such materials and work as might be necessary to carry out the plan, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate the sum of $2,447,906.56.

The State of New York has been accustomed to make an appropriation at every session of its legislature for the improvement of the Hudson River, and prior to 1867 the money was applied to the construction of dikes on the left bank of the river from Hotaling Island to Albany, to jetties, dams, and to temporary measures of relief, and also to dredging at the points where shoals were discovered after spring freshets. The present disposition of the State authorities is to leave the improvement solely to the General Government.

During the dry season of almost every year, for a month at least, no water flows over the State Dam at Troy, and excepting what comes in through the lockage of the canals, there is, during that period, little apparent fresh-water supply to the flow of the river. From this fact it is evident that the navigation of the Hudson River at the low stage is dependent in a large degree upon the tidal prism of the river.

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Mean rise and fall of tides, as determined by observations.

Locality.	1867.	1868.	1876.	1895.	1896.
	Feet.	*Feet.*	*Feet.*	*Feet.*	*Feet.*
State Dam, Troy, N. Y.	.....	.....	0.80	.....	.....
Nail works, Troy, N. Y.	.....	.....	1.95	.....	2.63
Albany, N. Y.	2.47	2.49	2.32	2.60	2.75
Castleton, N. Y.	.....	.....	2.54	2.62	.....
New Baltimore, N. Y.	3.55	.....	3.43	3.19	.....
Stuyvesant, N. Y.	.....	.....	3.65	.....	.....
Coxsackie, N. Y.	.....	.....	.....	3.69	.....
New York, Governors Island (from Coast Survey)	.....	.....	4.38	.....	.....

The mean duration of rise at Albany was 5 hours 10 minutes, and mean duration of fall 7 hours 15 minutes, in 1895.

Plane of mean low water at New York below that at points on Hudson River.

[Data from United States Coast and Geodetic Survey, 1896.]

Locality.	1867.	1868.	1876.	1895.	1896.
	Feet.	*Feet.*	*Feet.*	*Feet.*	*Feet.*
Coxsackie	.....	.....	.....	1.31	.....
Stuyvesant	.....	.....	1.13	.....	.....
New Baltimore	1.45	.....	1.31	1.60	.....
Castleton	.....	.....	2.13	2.18	.....
Albany	2.67	2.62	2.43	2.38	2.39
Nail works, Troy	.....	.....	2.98	.....	2.79
State Dam, Troy	.....	.....	4.53	.....	.....

Plane of mean high water at New York below that at points on Hudson River.

[Data from United States Coast and Geodetic Survey, 1896.]

Locality.	1867.	1868.	1876.	1895.	1896.
	Feet.	*Feet.*	*Feet.*	*Feet.*	*Feet.*
Coxsackie	.....	.....	.....	0.62	.....
Stuyvesant	.....	.....	0.40	.....	.....
New Baltimore	0.62	.....	.36	.41	.....
Castleton	.....	.....	.29	.43	.....
Albany	.76	0.73	.37	.61	0.75
Nail works, Troy	.....	.....	.55	.....	1.04
State Dam, Troy	.....	.....	.95	.....	.....

Slope of plane of mean low water per mile.

Locality.	1876.	1895.	1896.
	Feet.	*Feet.*	*Feet.*
From State Dam, Troy, to nail works, Troy	0.51	.....	.....
From nail works, Troy, to Albany	.12	.....	0.08
From Albany to Castleton	.04	0.04	.....
From Castleton to New Baltimore	.12	.12	.....
From New Baltimore to Stuyvesant	.05	.....	.....
From New Baltimore to Coxsackie	.....	.03	.....

The heights of the greatest known freshets above the plane of mean low water at Albany are as follows:

That of January 27, 1839, due to an ice gorge, was 17.78 feet.

That of March 15, 1846, due to an ice gorge, was 18.27 feet.

That of February 9, 1857, due to an ice gorge at Van Wies Point, was 22.19 feet.

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That of October, 1869, due to the great rainfall in that month, which reached 13.8 inches, was 19.04 feet.

That of February, 1886, due to an ice gorge, was 17.89 feet.

That of May 5, 1893, when there was a rainfall of 2.19 inches at Albany in twenty-four hours on the 3d and 4th, was 16.12 feet. In this freshet there was an observed slope of 0.57 foot per mile, on an average between Albany and New Baltimore, and as much as 0.80 foot per mile between Albany and Van Wies Point.

That of April 9–10, 1895, due to a warm rain, and the sudden melting of the snow at the head waters of the river, was 16.54 feet.

That of March 1, 1896, due to heavy rain, which caused a sudden rise and break-up of the ice, was 17.78 feet. There was no prolonged ice gorge near Albany, but the highest water was probably caused by a temporary gorge, for the ice was very strong when it broke up.

Generally speaking, the effects of rainstorms are shown by rise in the river within twenty-four hours. The winds also materjally affect the height of the water—south and east winds drive the water up the river, causing high tides, while a north or west wind produces an opposite effect.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

At the beginning of the fiscal year the following contracts were in force:

1. Contract with Edwards, Howlett & Thompson, dated December 23, 1892, which provided for the construction and repair of 40,000 linear feet of dike and for the dredging and removing of 4,620,000 cubic yards of material.

2. Contract with P. Sanford Ross, dated December 19, 1892, which provided for the removal of 190,000 tons of rock and 30,000 tons of sand covering rock.

3. Open-market agreement with Phillip J. Staats, dated March 17, 1896, for hire of steam launch.

During the fiscal year the following contracts were made:

1. Contract with William Parrott, dated September 11, 1896, providing for constructing about 2,225 linear feet of new dike and repairing about 2,000 linear feet of single-pile dike.

2. Supplementary contract with Edwards, Howlett & Thompson, dated February 19, 1897, providing for an increased price for the removal of 700,000 cubic yards, more or less, of material from the section of the Hudson River from the High Dike at or near Cuylers Island, to the foot of Broadway, Troy, N. Y.

Besides the above, the following open-market agreements were made during the fiscal year:

3. With E. M. Payn & Co., dated August 8, 1896, for hire of dredge, with scows and tugboat, for the examination of the material to be removed from the channel between the north end of High Dike and foot of Broadway, Troy, N. Y.

4. With William D. Fuller, dated November 10, 1896, for removal of wreck of canal boat near Matthews Point, New Baltimore.

5. With William H. Baldwin, dated November 20, 1896, for hauling out, wintering, repairing, painting, and launching United States surveying scow.

6. With Richard Parrott, dated January 22, 1897, for removing wreck of the tugboat *Chas. S. Many*, opposite Breaker Island.

7. With William D. Fuller, dated March 23, 1897, for driving guide piles to mark dikes submerged during freshets.

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8. With Phillip J. Staats, dated April 1, 1897, for hire of steam launch for use on Hudson River.

9. With Elmer Saulpaugh, dated April 28, 1897, for removing a sunken canal boat on the east side of the main channel at the "Imbought."

The sundry civil act of June 4, 1897, appropriated $475,000 for continuing the Hudson River improvement, which was allotted as follows:

For dredging under contract with Edwards, Howlett & Thompson	$220,000
For removing rock under contract with P. Sanford Ross	215,000
For purchasing paving stone and rubblestone	7,000
For repairing paving of dikes	7,000
For office and engineering expenses	26,000
Total	475,000

During the season of 1896 the work progressed very satisfactorily. Under the contract with Edwards, Howlett & Thompson the construction and repairs of dikes were continued until October 31, 1896, when the total sum allotted for dike work under their contract was expended. Repairs were completed on a section of the West Dike at New Baltimore Bar; piles driven for repairs of a portion of Papscanee Dike, section 1; piles driven and paving and rubble stone delivered for the repairs of Hillhouse Island and Port Schuyler dikes; and paving and rubble stone delivered for the paving of Patroon Lower Island Dike, Base Island Dike, and Breaker Island Revetment.

The dredging at the bars and shoals above Albany, in progress at the close of the last fiscal year, was continued until December 3, when ice caused the contractors to withdraw their plant for the season. As the dredges progressed towards Troy, the character of the material changed from sand and gravel to sand, very coarse gravel with cobblestones, and in some places bowlders mixed with clay, which it was found impracticable to handle economically by disposing of it behind the dikes with the pumps. In order to keep all the plant at work, four small dredges and three pumps were moved below Albany in the month of September, and were employed on the Bogart Light Shoal, south of Douws Point, and later in front of Castleton. There were nine dredges employed on the work when the season closed, three of them large dredges with an average daily capacity of 2,500 cubic yards each under favorable circumstances, but owing to want of sufficient scow capacity they did not average more than 1,200 cubic yards. The small dredges had a daily capacity of from 400 to 1,200 cubic yards each, but owing to loss of time in disposing of the dredged material the best of them did not average 800 cubic yards.

April 5, 1897, the contractors resumed work with the three large dredges, and began on the bars from Patroons Island north toward Troy, taking advantage of the high water to open narrow channels through the bars, in order to be able to use their large scows economically when the water in the river returned to its normal summer level.

Five centrifugal and two vacuum pumps were employed at one time during the season of 1896, and four centrifugal and one vacuum pump during the whole season until the close of navigation. These pumps were moored near the dikes behind which the material was to be deposited, and when the dredgings were dumped in front of them, lifted and put them behind the dikes, except one vacuum pump employed for a short time, which was so arranged that it lifted directly from the scows without dumping. This pump worked very well, but owing to the weight of the material, which was largely composed of coarse gravel, and even small cobblestones, it was not found to be economical, and lost much time on account of insufficient boiler power. The centrifugal pumps were the same as those employed last year and did good service,

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lifting as large cobblestones as the suction pipe would admit, but the heavy material above Albany cut down their capacity fully 50 per cent and caused frequent breakdowns. The shells of the pumps seemed to suffer most, and were worn so thin after a short period of work that they cracked and required patching. This trouble was in a measure guarded against late in the season by the use of cast steel for the shell, but the full efficiency of this was not tested when the work closed for the season, as the pumps on which it was tried were worked during the last two months on portions of the river where only sand had to be pumped.

These pumps disposed of about 400,000 cubic yards of dredgings back of the Cedar Hill, Douws Point, Patroons Lower Island, and Bath dikes. The rest of the material was towed in large scows about 35 miles down the river and dumped directly into the deep inner channel at the "Imbought," except 2,854 cubic yards which were removed to uncover a small reef of rock at Mulls Cross-Over, which was dumped directly from the small scows into the Hellegat channel and behind the New York State Dike at Mulls Cross-Over.

Since the resumption of dredging for the season of 1897 the material dredged has been towed to the "Imbought" and dumped, except 28,062 cubic yards, which were removed by small dredges from the bars at Troy. This has been taken to two pumps located on the west side of the river, one opposite Port Schuyler Dike, the other near Congress Street Bridge, and though the material was largely composed of very coarse gravel and small cobblestones, it has been lifted by the pumps and placed either behind the dike or in an abandoned canal basin.

Under the contract with P. Sanford Ross, the removal of rock and sand covering rock, in progress at the end of the last fiscal year, was continued until the formation of ice compelled the withdrawal of the plant December 5, 1896.

Three rock breakers and one movable platform, with spuds to hold it in position and upon which were three steam drills, were employed all of the season to break up the rock, which was removed by three clam-shell dredges. The progress was very satisfactory and a large area of rock was completely removed to the depth of 12 feet at mean low water.

When the season closed work on the reefs at North Coeymans and Mulls Cross-Over, below Albany, was still in progress. The main reef at Breaker Island had been completed, leaving a small section of the detached reef farther north still unfinished. At Troy the rock on the west side of the river had been broken up for a width ranging from 25 to 200 feet for a distance of nearly 1,000 feet, but no rock had been removed, and on the east side a good start had been made on the removal of the reef opposite and north of Congress street, where a rock breaker and steam drill plant and one dredge were employed; a rock breaker also worked over a small portion of the reef at the foot of Broadway. During the latter part of the season the work at Troy was delayed considerably by strong currents, occasioned by slight freshets, and the rock breakers being unable to work economically were withdrawn November 30, 1896.

The contractor returned to the work April 12 with two rock breakers and two clam-shell dredges. Work was resumed on the reef at Mulls Cross-Over with one dredge and one rock breaker; the other dredge was placed on the broken-up reef at Troy, on the west side of the river, and has made very good progress. One rock breaker was placed on the reef at Congress street as soon as the water was low enough for it to work; the other rock breaker has been working at Mulls Cross-Over and on the reef at the foot of Broadway, Troy. The machinery having

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been overhauled and repaired during the winter, is all in good working order, and the work has made very good progress.

Under the contract with William Parrott very little work was done during the season of 1896. Mr. Parrott was delayed by other work in getting started and by high water later, so that the repair of only a very small portion of the single-pile dike in Papscanee Dike, Section I, was completed. The contractor returned to the work April 27, 1897, but owing to high water and stormy weather did not begin driving piles until the 29th to close the gap between Papscanee Dike, Section I and Section II, and later resumed work on the repair of the single-pile dike and on the new dike to close the gap between Papscanee Dike, Section II and Section III. Considering the high stages of the river during the month of May, and the stormy weather during that month and part of June, very fair progress has been made by the contractor.

The progress of the work done by the contractors during the past fiscal year may be summarized as follows:

CONSTRUCTION OF NEW DIKES.

Under contract with William Parrott, the following dike has been constructed during the fiscal year:

Extension of Papscanee Dike, Section I, is built on the plan of a full dike 7 feet wide, and closes the opening between Section I and Section II of the Papscanee dikes on the Overslaugh. It is still in process of construction.

The extension of Papscanee Dike, Section II, to close the gap between it and Section III, is built on the plan of a full dike 7 feet wide, and is in progress, piles having been driven a portion of the distance only.

REPAIRS OF EXISTING DIKES.

Under contract with Edwards, Howlett & Thompson, repairs were made to 980 linear feet of the west dike at New Baltimore Bar by building a new channel face to the dike and driving sufficient piling at the back to securely hold new waling pieces, and then filling it with stone. This work was in progress at the end of the fiscal year 1896, and was completed August 22, 1896, at a cost of $3.04 per linear foot of dike rebuilt.

Additional stone filling was put into Campbell Island Dike to restore it where the original filling had settled. New piling was driven and cut off for the repairs of a section of Papscanee Dike, Section I, and for the footing course of Hillhouse Island Revetment and Port Schuyler Dike.

Rubble and paving stone were delivered for repairs of the paving of Overslaugh Dike No. 1, Patroons Lower Island Dike, Base Island Dike, Patroons Island Revetment, Hillhouse Island Revetment, Breaker Island Revetment, and Port Schuyler Dike.

Under the contract with William Parrott, the repairs of 305 feet of the single-pile section of Papscanee Dike, Section I, have been completed and the repairs of the remainder are still in progress.

During the past fiscal year the amounts of materials delivered and put in place by the contractors for dike construction and repairs were as follows:

41,452 linear feet of pine piling.
2,315 linear feet of round timber.
43,401 feet B. M. of square timber.
23,121 pounds of tie-rods, screw bolts, drift bolts, spikes, and washers.
2,817.3 cubic yards of rubble stone.
1,914 cubic yards of paving stone.

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DREDGING.

The dredging that was in progress at Bath and Kellogg shoals at the close of the last fiscal year was continued, and in addition to progressing up the river toward Troy, has been done at Mulls Cross-Over, Castleton and Cedar Hill bars, Bogart Light Shoal, on Douws Point Cross-Over, and in front of Albany.

The following amounts of material were dredged and removed during the fiscal year, viz:

	Cubic yards.
At Mulls Cross-Over	2,854
At Castleton Bar	80,280
At Cedar Hill Bar	2,538
At Bogart Light Shoal	38,785
In front of Albany	21,315
At Bath Shoal	111,134
At Kellogg Shoal	211,994
At Fishhouse Shoal	126,490
At Round Shoal	251,932
At Covills Folly	73,497
Opposite Breaker Island	40,401
At Van Buren Bar	63,692
At Washington Bar	33,669
Opposite Watervliet Arsenal	7,451
Opposite foot of Broadway, Troy	843
Total	1,066,875

REMOVAL OF ROCK.

Under the contract with P. Sanford Ross, the work of removing from the channel all rock above the plane of 12 feet at mean low water, which was in progress at the end of the last fiscal year, was continued, and work was begun on reefs at Troy on the west side of the river and at Congress street and Broadway.

The following table shows the amounts estimated as removed during the fiscal year just ended, viz:

Locality.	Rock.	Sand covering.
	Tons.	*Tons.*
Stone House Bar	26.3	.....
North Coeymans	730.1	148
Mulls Cross-Over	25,422.4	1,735
Breaker Island	17,391.7	.....
West side of river, Troy	5,613	689
Congress street, Troy	7,849	1,015
Total	57,032.5	3,587

WRECKS.

During the fiscal year three wrecks were removed from the channel of the river at the following localities, viz:

By authority dated November 9, 1896, the remains of a sunken canal boat lying on the edge of the channel just above Matthews Point, New Baltimore, N. Y., at a cost of $148.

By authority dated December 28, 1896, the wreck of the tugboat *Chas. S. Many*, which was burned and beached on the east side of the Hudson River, opposite Breaker Island, at a cost of $190.

By authority dated April 28, 1897, the sunken canal boat lying on the west side of the channel of the Hudson River at the "Imbought," about opposite Green or Van Orden Point, at a cost of $145.

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EXAMINATION OF MATERIAL TO BE REMOVED.

Under authority from the Chief of Engineers, dated August 8, 1896, a dredge with scows and tugboat was hired from E. M. Payn & Co. to dig pits between the north end of High Dike and foot of Broadway, Troy, in order to test the character of material to be dredged. Seventy-five pits were dug and full notes of the location of the pits and of the material dredged were made, at a total cost of $588.

HIRED LABOR.

A foreman and about 48 men were kept continuously employed repairing and relaying the paving on Patroons Lower Island and Base Island dikes and Hillhouse Island Revetment, where the work had been weakened and damaged by the ice gorges, freshets, and steamboat waves.

In the month of December a foreman with 14 men made some repairs to the paving of Overslaugh Dike No. 1 by patching it where it was broken, mostly at the footing course, and in patching up and strengthening the paving of Breaker Island Revetment, which was showing great deterioration for about two-thirds of its length.

The repairs of the paving of Patroons Lower Island Dike were completed August 24, at a cost of $5,505.55, or about 75 cents per square yard for tearing up and relaying the paving. The total cost of this dike to date is about $7.10 per linear foot.

The repairs of the paving of Base Island Dike were not entirely finished when the work was suspended for the season. The total expense incurred for hired labor on this dike was $6,137.31 and the total cost per linear foot of dike to date is about $6.05.

The repairs of Hillhouse Island Revetment were still unfinished at the close of the season, and the cost to date for hired labor is $991.

Since June 1, 1897, a foreman and 8 men have been employed in leveling off and relaying the stone in Campbell Island Dike, which had settled considerably in some portions.

HYDROGRAPHIC AND OFFICE WORK.

The hydrographic party was employed in making surveys and examinations before and after dredging and rock removal, and in setting ranges and tide staffs for dredging and rock removal. During the season of 1896 soundings were taken to develop the condition of the channel from north end of High Dike to Congress Street Bridge at Troy, where no dredging was done, and after the dredging was abandoned for the season, at Castleton Bar, Bogarts Light Shoal, opposite Douws Point, and from the New York Central and Hudson River Railroad passenger bridge at Albany, to the north end of High Dike. Surveys were also made of New Baltimore Bar near Willow Island Light, of Mulls Cross-over from North Coeymans ice house to the end of the Stone Dike, and where pumping was done at the pumps, in order to determine the amounts to be deducted from the quantities estimated by the inspectors on the dredges, as removed from the channel, which had not been deposited behind the dikes after being dumped at the pumps.

The reefs of rock at Stone House and New Baltimore bars, which had been reported as entirely removed, were examined late in the season and soundings and borings from 1.5 to 2 feet apart taken over the original area of the rocks to be removed.

Large reefs of rock having been found to exist at the foot of Congress

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street and foot of Broadway, Troy, borings and soundings were made to develop the area and give data for calculating the probable quantity of rock to be removed from them.

Since the resumption of navigation this season, surveys to determine the condition of the channel have been made at Stone House Bar, New Baltimore Bar, Mulls Cross-over, Nine Mile Tree Cross-over, Castleton, Cedar Hill, and Winnies bars, from Van Wies Point to Albany, and from New York Central and Hudson River Railroad passenger bridge at Albany to the north end of High Dike.

In the office the notes of the surveys have been platted and tracings have been made of the maps. Calculations have been made of the quantities dredged below the contract depth on the various bars, and of those left by the pumps at the different pumping stations, and a revised estimate has been made of the quantities remaining to be removed from the channel between Albany and Troy, using the latest soundings. The quantities of rock within the channel limits between Albany and Troy, so far as developed by survey, which it is required to remove, have been calculated. The records of the self-registering tide gauges, which were in operation at Albany during the whole season, and at Breaker Island, opposite the old nail works tidal station of 1876, were read off and reduced.

During the months of February and March, with the exception of a few days, the employees of the office were reduced to assistant engineer, draftsman, and recorder, who were engaged in tracing maps of surveys and reducing tidal observations.

GENERAL REMARKS.

The following table is compiled from the data furnished by the latest surveys and examinations of the various bars, and shows the depth and width on the shoalest places as compared with the depth and width in 1896:

Bar.	1896.		1897.	
	Width.	Depth.	Width.	Depth.
	Feet.	*Feet.*	*Feet.*	*Feet.*
Coxsackie Shoal	300–400	12	300–400	12
Stone House Bar	400	12	200	12
New Baltimore Bar	300	11.2	100	11
Coeymans Cross-over	250	11.5	250	11.5
Mulls Cross-over	150	11.5	150	11.5
Nine Mile Tree Cross-over	250–400	11.5	200	11.5
Castleton Bar	400	11	250	11.5
Cedar Hill Bar	150–350	12	100	11.5
Winnies Bar	250–400	12	150	12
Stone Light Shoal	400	12	100–400	11.5
Bogart Light Shoal	150	12	100	12
	300	11	250	11
Douws Point Cross-over	100	11.7	50	12
	300	11	300	11
Cuylers Bar	100	12	200	12
	350	11	400	11
Bath Shoal:				
Through channel	150–400	10	170	10.5
South of old cross dike, Patroons Lower Island	150–400	11	170	10.5
North of old cross dike, Patroons Lower Island	.....	.....	250–400	12
Kellogg Shoal	100–150	9	300	12
Fishhouse Shoal	150–200	9	260	12
Round Shoal	100–200	9	200–300	12
Covills Folly	100–150	8.8	200	12
Opposite Breaker Island	.....	.....	120–200	12
Van Buren Bar	100–200	9	120	12
Washington Bar	150	8.5	40	12
Opposite Watervliet Arsenal	60	9	60	9
Watervliet Arsenal to Congress street, Troy	100	9	100	9
Congress street, Troy, to foot of Broadway, Troy	150	8.5	150	8.5

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There have been no heavy freshets in the river during the past fiscal year and there are, therefore, not data enough on which to form an opinion as to the stability of the dredged channel above Albany. The latest surveys, however, seem to indicate that the dredged channel will maintain its depth through the Kellogg, Fishhouse, and Round shoals and also from Round Shoal to Washington Bar, but opposite the lower end of Patroons Island the river widens to double its width above and heavy shoaling has taken place. This section will need continuous dredging to keep the required depth. The channel dredged through the bars between Coxsackie and Albany, with the exception of the New Baltimore Bar just above Willow Island Light, shows little change except where dredging was done last year. At the New Baltimore Bar there is evident deterioration and the channel is losing its depth every year. Some of this loss may be the after effects of the ice gorge in the spring of 1896, for no dredging was done last summer, but it can not all be accounted for in that way, and this condition seems to indicate that unless the gap between Willow Island Light and the New Baltimore State Dike is closed, this bar will require continuous dredging to keep the required depth over it.

The general condition of the timber in the old dikes which have not been practically rebuilt is not good, and it is only a question of a short time before extensive repairs will be needed. The new dikes, with a little attention and occasionally a small addition to the stone filling, will keep in good condition and require only moderate expenditure for some years to come.

Of the old dikes which require repairs at an early date, the New York State dikes at New Baltimore Bar and above Nine Mile Tree may be mentioned as those which should be repaired at once. New piling and waling pieces with stone filling are badly needed and in some sections should be supplied at an early date or the dikes may be broken by the ice, and large quantities of the material which has accumulated behind them would come into the channel. Of the United States dikes requiring repair, those most in need of it are a portion of the half dike on Mulls Island opposite Coeymans, Shad Island Dike, a portion of the Cedar Hill Dike at Poplar Island, about 2,000 feet of Winnies Dike, and the three sections of the Papscanee dikes on the Overslaugh; the New York State dike at Cuylers Bar needs some repairs now, and will need extensive repairs in a few years.

This improvement has been under the local charge of Mr. R. H. Talcott, assistant engineer, who has well and faithfully discharged the duties assigned to him.

This work is in the collection district of New York, Albany being a port of entry.

Money statement.

July 1, 1896, balance unexpended		$608,995.09
Amount appropriated by sundry civil act approved June 4, 1897		475,000.00
		1,083,995.09
June 30, 1897, amount expended during fiscal year		576,438.52
July 1, 1897, balance unexpended		507,556.57
July 1, 1897, outstanding liabilities	$118,610.33	
July 1, 1897, amount covered by uncompleted contracts	350,397.93	
		469,008.26
July 1, 1897, balance available		38,548.31
Amount (estimated) required for completion of existing project		160,406.56
Amount that can be profitably expended in fiscal year ending June 30, 1899		160,406.56

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

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AMOUNTS APPROPRIATED.

Act of—		Act of—	
June 30, 1834	$70,000.00	July 7, 1838	$100,000.00
July 2, 1836	100,000.00	August 30, 1852	50,000.00
March 3, 1837	100,000.00		
		Total	420,000.00

AMOUNTS APPROPRIATED UNDER PROJECT OF 1867.

Act of—		Act of—	
June 26, 1864, allotment	$33,000.00	March 3, 1879	$30,000.00
June 23, 1866	50,000.00	June 14, 1880	20,000.00
March 3, 1867	305,188.00	March 3, 1881	15,000.00
July 25, 1868	85,000.00	August 2, 1882	10,000.00
April 10, 1869	89,100.00	July 5, 1884	30,000.00
July 11, 1870	40,000.00	August 5, 1886	26,250.00
March 3, 1871	40,000.00	August 11, 1888	75,000.00
June 10, 1872	40,000.00	September 19, 1890	150,000.00
March 3, 1873	40,000.00		
June 23, 1874	40,000.00	Total	1,278,538.00
March 3, 1875	40,000.00	Received from other sources	792.57
August 14, 1876	50,000.00		
June 18, 1878	70,000.00	Total	1,279,330.57

AMOUNTS APPROPRIATED UNDER PRESENT PROJECT.

Act of—		Act of—	
July 13, 1892	$187,500.00	June 11, 1896	$480,000.00
March 3, 1893	500,000.00	June 4, 1897	475,000.00
August 18, 1894	145,000.00		
March 3, 1895	500,000.00	Total	2,287,500.00
Amount expended to June 30, 1897			1,779,943.43

Abstract of proposals for constructing and repairing dikes in the Hudson River, New York, received in response to advertisement dated July 10, 1896, and opened August 15, 1896, by Col. G. L. Gillespie, Corps of Engineers.

No.	Name of bidder.	Pine or spruce piles, 107,000 linear feet.		Yellow pine square timber, 125,500 feet B. M.		Tie-rods and screw-bolts, 38,000 pounds.	
		Per linear foot.	Amount.	Per 1,000 feet B. M.	Amount.	Per pound.	Amount.
1	Spearin & Preston	$0.27½	$29,425.00	$38.00	$4,769.00	$0.05	$1,900.00
2	David V. Howell	.18	19,260.00	44.00	5,522.00	.06½	2,470.00
3	The International Contracting Co.	.15	16,050.00	38.00	4,769.00	.06	2,280.00
4	John L. Grim	.12¾	13,642.50	38.00	4,769.00	.03¾	1,425.00
5	J. & F. Kelly	.18½	19,795.00	40.00	5,020.00	.04	1,520.00
6	Wm. D. Fuller	.11½	12,438.75	38.00	4,769.00	.04	1,520.00
7	William Parrott	.11	12,305.00	35.00	4,392.50	.04	1,520.00
8	Frank Pidgeon	.14	14,980.00	38.00	4,769.00	.04¾	1,805.00

No.	Name of bidder.	Drift-bolts, spikes, and washers, 24,000 pounds.		Rubble stone, 4,000 cubic yards.		Total.
		Per pound.	Amount.	Per cubic yard.	Amount.	
1	Spearin & Preston	$0.04	$960.00	$1.00	$4,000.00	$41,054.00
2	David V. Howell	.04½	1,080.00	1.18	4,720.00	33,052.00
3	The International Contracting Co	.05	1,200.00	1.25	5,000.00	29,299.00
4	John L. Grim	.03¾	900.00	1.05	4,200.00	24,936.50
5	J. & F. Kelly	.04	960.00	1.35	5,400.00	32,695.00
6	Wm. D. Fuller	.04	960.00	.94	3,760.00	23,447.75
7	William Parrott	.04	960.00	.90	3,600.00	a22,777.50
8	Frank Pidgeon	.04½	1,080.00	1.00	4,400.00	27,034.00

a Lowest bid.

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CONTRACTS IN FORCE.

Continuing contract with P. Sanford Ross, dated December 19, 1892, approved by the Chief of Engineers February 10, 1893, for removing rock and sand covering from the channel between Coxsackie and State Dam at Troy: $25,000 allotted from act July 13, 1892; $165,000 from act March 3, 1893; $45,000 from act August 18, 1894; $200,000 from act March 2, 1895; $260,000 from act June 11, 1896, and $215,000 from act June 4, 1897.

Continuing contract with Edwards, Howlett & Thompson, dated December 23, 1892, approved by the Chief of Engineers March 2, 1893, for construction and repair of dikes, and for dredging between Coxsackie and State Dam: $135,000 allotted from act July 23, 1892; $309,000 from act March 3, 1893; $90,000 from act August 18, 1894; $275,000 from act March 2, 1895; $180,000 from act June 11, 1896, and $220,000 from act June 4, 1897.

Supplementary contract with Edwards, Howlett & Thompson, dated February 19, 1897, for modification in price for dredging heavy material under above contract.

Contract with William Parrott, dated September 11, 1896, approved by the Chief of Engineers September 30, 1896, for constructing and repairing dikes in the Hudson River; work to begin October 1, and to be completed by December 1, 1896; extended to December 1, 1897.

COMMERCIAL STATISTICS.

The importance of the Hudson as a great waterway of commerce is apparent when it is known that aside from its own local traffic, which in itself is very large, it absorbs all the traffic of the Erie, Champlain, and Delaware and Hudson canals, besides the great coal trade of the Pennsylvania Coal Company at Newburg, and the Erie coal trade at Piermont. The average season of navigation of the river is 240 days and that of the canals 220 days.

The Erie Canal, extending from Albany to Buffalo on Lake Erie, a distance of 352 miles, with a difference of level of 577 feet, and to Oswego, on lake Ontario, connects the Great Northern Lakes with the Hudson River and brings in immense commerce from the Northwest and Canada. The principal items of this commerce are lumber and grain.

The Champlain Canal, 69 miles long, connects Lake Champlain with the Hudson River. This lake, which is 93 feet above tide of the Hudson, and whose waters flow into the St. Lawrence, is connected by the Chambly Canal with the St. Lawrence River below Montreal. The principal items of tonnage on this canal are lumber and iron ore. The above canals, with 575 miles of subsidiaries, constitute the New York State canals. The Erie Canal enters the Hudson by three tide-water locks—one at the foot of Twenty-third street, West Troy; one at the foot of Eighth street, West Troy, and a third at the lumber district, Albany.

The Champlain Canal enters the river at Waterford, 3 miles above the State Dam, and boats are locked through the dam to tide water. It is also connected with the Erie Canal and, through its tide-water locks, with the Hudson River.

The Delaware and Hudson Canal enters the Hudson through Rondout Creek at Rondout, N. Y., and brings the anthracite coal country at Honesdale and the Delaware River into water communication with the Hudson. The principal items of tonnage on this canal are coal, bluestone, and cement. Aside from the above feeders to the commerce of the Hudson, the Pennsylvania Coal Company has a large tide-water coal depot at Newburg, where also the Erie Railroad has a terminal point and transfers large quantities of freight by boat across the river. The Erie Railroad also has a coal depot at Piermont, 20 miles above New York, where preparations are being made to handle a very large supply.

The following statistics include the tonnage received at all points above Spuyten Duyvil Creek and of the local shipment between points on the river; only that shipped is credited to the points from which it was shipped, no entry being made to the total tonnage of the amount received at local points from other local points. The total tonnage also includes all through freight shipped from points up the river that passed the mouth of Spuyten Duyvil Creek going south.

The two principal industries on the river which add materially to the total tonnage are ice and brick. The capacity of the ice houses on and adjacent to the river

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exceed 4,000,000 tons, and amount generally harvested 3,500,000. The brick manufactured on the river exceeds 850,000,000.

Total tonnage of all shipping points on the Hudson River during 1889, not including the tonnage coming through State canals.....tons..	15,033,309
Value of same.....	$378,196,094
Total tonnage coming to and leaving tide water through State canals, 1889.....tons..	2,056,366
Value of same.....	$60,143,852
Grand total tonnage of the Hudson River, including the tonnage through State canals.....tons..	17,089,675
Value of same.....	$438,339,946

This does not include the value of vessels carrying the above trade, which are equally exposed to the dangers of navigation.

Number of transportation companies for passengers or freight, not including steamboats or pleasure boats.....	30
Total number of passengers carried, 1889.....	5,000,000
Total population along the river, 1890.....	450,000

The amount of commerce of the section of the river within the limits of the improvement now in progress, for the season of navigation of 1896, is estimated at about 5,300,000 tons, and consisted principally of merchandise, lumber, iron ore, salt, grain, brick, hay, and ice, but includes all products of the forest, mines, agriculture, and manufacture, with a total estimated valuation of about $106,400,000. These figures do not vary materially from those reported for the season of 1895.

In connection with the above statement attention is invited to the following testimonial of the Ronan line, received July 10, 1896, viz:

"Your esteemed favor of the 16th instant at hand and noted. Regarding the benefits this line has reaped from the improved channel would say that they are incalculable. As you are already aware, the propellers of this line are the deepest draft vessels that navigate the Hudson River from the city of Hudson to Albany. Prior to the improvements to the river we were compelled almost daily to send our large steamboats (drawing 12 feet of water) on raising tide to enable them to clear all the shoal spots from this city to Stuyvesant. In numerous instances when we have sent our boats away on raising water they have grounded, and as a result broke propeller wheels. For the past year we have been sending our large-draft propellers from here on dead low water, and their progress is unimpeded. The result of the recent improvements means to this concern an actual saving of thousands of dollars annually. We have been enabled, as a result of the deepened channel, to lower our insurance, save the breaking of propeller wheel, the cost of outside power, wear and tear, and hulls, and machinery, etc. To us the improvements are a grand thing, and should the channel remain in the excellent condition in which it now is no trouble will be experienced from grounding."

Commercial statistics of the port of Albany, N. Y., from July 1, 1896, to July 1, 1897.

Amount of revenue collected.....	$112,054.99
Value of all imports.....	176,801.00
Value of all exports.....	133.00

Statement of the number and tonnage of all vessels belonging to the port of Albany, July 1, 1897.

	Number.	Registered tonnage.
Steam vessels.....	156	25,414.40
Sailing vessels.....	31	2,206.14
Barges.....	51	10,976.67
Canal boats.....	136	13,797.95

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Bridges across the Hudson River.

The following table gives the location and essential features of all the bridges which cross the line of navigation of the river:

Name and location of bridge.	Draw span.	Width in clear in each draw.	Height of bottom chord above mean high water.
	Ft. in.	*Ft. in.*	*Ft. in.*
Delaware and Hudson Railroad Bridge at Bridge Avenue, Troy, N. Y. *a*	198 6	61 6	23 6
Congress street Bridge, Troy, N. Y. *b*	258 0	104 0	29 6
New York Central and Hudson River Railroad Upper Bridge, Albany, N. Y. *c*	275 0	110 *f*	53 5
New York Central and Hudson River Passenger Railroad Bridge, Albany, N. Y. *d*	275 0	115 4	23 1
Lower Bridge, or Greenbush Bridge, Albany, N. Y. *e*	400 0	169 8	22 7
The Poughkeepsie Bridge, Poughkeepsie, N. Y. *f*	.....	.....	160 0

a Railroad, wagon and passenger bridge; iron, on stone piers; drawpier on land, east shore; the only opening through which boats ply is 56 feet 6 inches in clear from dock line, east shore; draw opened by steam power; 4 piers in main channel of the river east of Starbuck Island; respective widths in clear between piers, 170 feet 6 inches, 173 feet 6 inches, 173 feet 6 inches, and 160 feet to east shore line of Starbuck Island; 2 piers in channel of river west of Starbuck Island; width in clear from west shore line of Starbuck Island to first pier, 150 feet 5 inches; between first and second piers, 177 feet 5 inches, and from second pier to Green Island Dock line, 68 feet 6 inches, making 6 piers in river at right angles to direction of stream.

b Wagon and passenger bridge; double draw, opened by hand power; iron, on stone piers, slightly oblique to direction of stream; 2 piers and drawpier in river; width in clear from east pier to dock, 205 feet 3 inches; width in clear from west pier to West Troy Shore line, 210 feet.

c Railroad freight bridge; double draw, opened by steam power; iron, on stone piers at right angles to direction of stream; 4 piers and drawpier in river between bulkhead lines; respective widths in clear, 146 feet, 170 feet, and 170 feet, commencing at Columbia pier dock line.

d Railroad and passenger bridge; double draw, opened by steam power; iron, on stone piers at right angles to direction of stream; 4 piers and drawpier in river; respective widths in clear, 146 feet 5 inches, 175 feet, 175 feet, and 119 feet, commencing at Columbia pier dock line.

e Wagon and passenger bridge; double draw, opened by steam power; iron, on stone piers at right angles to direction of stream; 2 piers and drawpier in river; width in clear from west pier to Quay street dock line, 186 feet 3 inches; width in clear from east pier to shore line pier, 236 feet 3 inches.

f No draw; railroad bridge; iron, on iron piers, with stone foundations, at right angles to stream; 4 piers in river; 5 spans, 548 feet, 525 feet, 546 feet, 525 feet, and 548 feet; cantilever bridge.

E 2.

IMPROVEMENT OF HARBOR AT SAUGERTIES, NEW YORK.

[This work was in charge of Maj. H. M. Adams, Corps of Engineers, to March 31, 1897.]

The harbor of Saugerties is formed by the mouth of Esopus Creek, which empties into the Hudson River on its west shore about 100 miles above New York City. The creek is from 180 to 500 feet wide, and is navigable for about three-fourths of a mile from its mouth, above which point are rapids and a dam. The natural depth within the creek was 7 feet or more at mean low water, but a broad bar at the entrance had but 3 feet depth. Efforts had been made by citizens to deepen the harbor entrance by permanent works previous to 1887, but without permanent benefit.

The mean rise and fall of tides at Saugerties is about 4 feet.

PROJECT FOR IMPROVEMENT.

The river and harbor act of 1882 ordered a survey of this harbor. The report upon the survey submitted plans and estimates for making the channel 7 feet deep at mean low water and 100 feet wide by building parallel dikes and dredging between them. (Annual Report of the Chief of Engineers for 1884, p. 716.)

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The plans were slightly modified as to location in 1887, before work was begun, and the estimates presented at that time were as follows:

North dike, 2,300 feet long	$19,320
South dike, 2,300 feet long	18,400
Dredging 30,000 cubic yards, at 25 cents	7,500
Contingencies, etc., about 15 per cent	6,780
Total	52,000

In the meantime a channel 200 feet wide and 8 feet deep had been dredged through the entrance by the State of New York, 29,000 cubic yards of sand having been removed, and in 1887, when work by the United States was begun, the available depth in this channal was about 7 feet at mean low water.

June 30, 1892, after $42,000 had been appropriated for and expended upon this work, the dikes and channels were completed practically as designed. The north dike was 2,058 feet long, the south dike 2,363½ feet long, and the water way between them 260 feet wide, for 150 feet of which there was a depth of 9 feet at mean low water.

Subsequent appropriations have been applied to repairing and maintaining the dikes and to maintaining or slightly increasing the width of the channel by removal of rocks and by dredging.

No surveys have been made since 1895, when the channel between the dikes was 8 feet deep at mean low water and fully 200 feet wide. The dikes were generally in fair condition, but the south dike needed some repairs at several points.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

In the month of July, 1896, specifications were prepared and advertisements made by public notice for bids for furnishing materials in place for repairing the south dike. Proposals were received and opened August 3, 1896. With the approval of the Chief of Engineers the contract was awarded to Frank Pidgeon, the lowest bidder, and signed August 19, 1896.

Work on the repairs was begun September 8 and completed October 31, 1896.

The total amount of material used was as follows, viz:

Piles driven and sawed off	linear feet..	8,541
Timber placed	feet B. M..	6,625.4
Screw bolts used	pounds..	1,458.09
Drift bolts used	do....	513.75
Stone filling placed, at a total cost of $2,632.21	cubic yards..	651.50

A small break in the north dike was also repaired under agreement with Frank Pidgeon at a cost of $164.30.

PRESENT CONDITION OF THE IMPROVEMENT.

The dikes are both in good condition, except for the natural deterioration of the timber work and tops of piling, which, being always out of water, except in either a freshet in the creek or extremely high storm tides, have become much decayed and will soon require extensive repairs.

There is no survey of later date than September, 1895, and nothing definite can be said as to the exact condition of the channel. The pilots on the steamboats which use the channel report that the depth has certainly held its own since the last survey, and that there has been an improvement if there has been any change.

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The only complaint made is of the channel inside the creek, where, owing to sharp bends, navigation is difficult.

PROPOSED OPERATIONS.

The project for the improvement is completed. No further work is proposed except for the maintenance of that already done. The average annual cost of maintaining the improvement is estimated at $2,500. The available funds are so small that it is not proposed to use them at present, unless in case of emergency for maintaining the dikes.

Saugerties is in the collection district of Albany, of which Albany, N. Y., is the port of entry. The nearest light-house is at the harbor entrance.

Money statement.

July 1, 1896, balance unexpended	$3,865.03
June 30, 1897, amount expended during fiscal year	3,523.33
July 1, 1897, balance unexpended	341.70
Amount that can be profitably expended in fiscal year ending June 30, 1899. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	2,500.00

Appropriations for improving the harbor at Saugerties, N. Y., have been made as follows:

Application.	Date.	Amount.
Constructing south dike in 1887	July 5, 1884	$5,000
Do	Aug. 5, 1886	15,000
Beginning north dike, dredging	Aug. 11, 1888	12,000
Completing north dike	Sept. 19, 1890	10,000
Repairing dikes and dredging	July 13, 1892	5,000
Do	Aug. 17, 1894	5,000
Do	June 3, 1896	2,500
Total		54,500

Amount expended to June 30, 1897, $54,158.30.

Abstract of proposals for repairing dike at Saugerties Harbor, New York, received in response to public-notice advertisement of ten days and opened August 3, 1896, by Maj. H. M. Adams, Corps of Engineers.

Articles.	1. Frank Pidgeon.[a]		2. Spearin & Preston.	
	Per unit.	Amount.	Per unit.	Amount.
Round piles driven (4,500 linear feet) linear feet	$0.18	$810.00	$0.25	$1,125.00
Yellow pine, fitted in place (4,300 feet B. M.) 1,000 feet B. M.	40.00	172.00	40.00	172.00
Screw bolts, heads, nuts, and washers, in work (900 pounds), pound	.06	54.00	.03	27.00
Driftbolts, in work (500 pounds) pound	.05	25.00	.03½	17.50
Stone for filling and building up dike (600 cubic yards), cubic yard	1.10	660.00	1.75	1,050.00
Total bid		1,721.00		2,391.50

[a] Lowest bid.

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CONTRACT IN FORCE.

With Frank Pidgeon, dated August 19, 1896, approved by the Chief of Engineers August 31, 1896, for repairs to the south dike, at cost of $1,721. Work was begun September 8 and completed in November, 1896.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

The number of boats employed in carrying freight and passengers is 25, with a total tonnage of 4,500 tons. The Saugerties and New York Steamboat Company has a daily line to New York, and there is a steamboat connection with Rondout and Hudson.

The following table, which gives the total tonnage and estimated value of the freight carried in 1896 by vessels doing freighting in the harbor, shows a large decrease in the traffic reported for 1895. This is accounted for by the stoppage of the manufacturing establishments on account of the depression and business troubles.

Chief articles.	Tons.	Estimated value.
Bluestone	100,000	$1,200,000
Coal	10,000	30,000
Building material	2,500	26,000
Merchandise	5,000	500,000
Miscellaneous (hay, fruit, ice, etc.)	2,800	14,500
Total	120,300	1,770,500

The above figures show a decrease in tonnage of freights of 25,000 tons below the amount reported for 1895.

The total number of passengers carried is estimated at 20,000.

E 3.

IMPROVEMENT OF HARBOR AT RONDOUT, NEW YORK.

[This work was in charge of Maj. H. M. Adams, Corps of Engineers, to March 31, 1897.]

The harbor of Rondout is at the mouth of Rondout Creek, which empties into the Hudson River on the west side, about 90 miles above New York City. The creek is a tidal stream from the entrance to the first lock of the Delaware and Hudson Canal, a distance of 3 miles. The mean rise of tide is about 4 feet.

Prior to 1871 improvements had been made by private persons and corporations, without permanent benefit. In compliance with a resolution of the House of Representatives, of June 28, 1869, a report upon the harbor was submitted containing plans and estimates of cost for its improvement (Annual Report of the Chief of Engineers for 1869, p. 393), based on such information as could be obtained from the United States Coast Survey charts and other sources.

The river and harbor act of 1871 provided for a survey of the harbor, which was made in the same year. The report upon this survey, dated January 25, 1872 (Annual Report of the Chief of Engineers, 1872, p. 810), submitted a plan for making a channel 100 feet wide and 14 feet deep at mean low water, through the harbor entrance (about 3,000 feet), protecting the same by two parallel pile dikes, with a branch dike on the north or upstream side of the entrance to "guide the down current of the Hudson near the west bank into a direction nearly coincident with the current from the creek" (as stated in the report of 1869).

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The cost was estimated as follows:

North dike, 748 yards long	$41,600
Branch dike, 604 yards long	34,400
South dike, 1,277 yards long	59,600
Dredging, 48,000 cubic yards, at 30 cents	14,400
Contingencies and engineering, 15 per cent	22,500
Total	172,500

The estimated lengths of the dikes were considered approximate, the lengths actually necessary to be determined as the work progressed.

Work under this project was begun in 1872, after the first appropriation had been made, and the project was completed in 1880, the north dike being made 1,800 feet long, the branch dike 1,000 feet long, and the south dike (including 400 feet of single piling) 2,800 feet long, with a spur 330 feet long to the light-house. The width of waterway between the dikes, at the entrance, was made about 350 feet; 59,800 cubic yards of material had been dredged, and as a result the channel from the creek to the Hudson River was reported to have 13½ feet depth for 50 feet wide, 12 feet depth for 100 feet wide, and 10 feet depth for 200 feet wide. At the entrance the 12-foot channel was over 300 feet wide. This work had been accomplished at a cost of $90,000 (not including the repairs made under special allotments of $1,000 in 1875); it was found that the dikes were not required for the full length originally designed, and the prevailing prices for the work were much lower during the period of construction than they had been before. The dikes were all built to mean high-tide level except 600 feet of the south dike, west of the light-house, which was originally built to half tide, but was raised by crib work in 1882.

The dikes are covered by every unusually high tide and by freshets, and it has been found necessary to mark them by high piles, and to drive fender piles along their faces to enable vessels to enter the harbor in safety during high water.

Appropriations since 1880 have been applied to repair of the dikes, removing decayed and damaged timbers, replacing stone filling after settlement, driving fender piles and renewing them nearly every year.

In 1884 a small amount of dredging was done and 150 linear feet of the south dike, at the outer end, was taken up at the request of boatmen, who thought that a wider entrance was necessary for tows entering during flood tide. The increased width was obtained and desired; subsequent surveys indicated that it was probably at the expense of a tendency to form a shoal at that point, and it has been proposed to extend the south dike whenever funds are available for the purpose.

In 1889 the necessary repairs were estimated to cost $25,000, which, with $101,500 already expended, would make the total cost $126,500.

July 1, 1895, the entrance channel was 12 feet deep at mean low water for a width of 70 feet or over, and the channel of 10 feet depth was 150 feet wide; there was a narrow channel close to the north dike with slightly more than 13 feet available depth.

Sketches showing the work in Rondout Harbor, New York, were printed in the Annual Reports of the Chief of Engineers, as follows: Report of 1880, page 494; Report of 1885, page 698.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

There was no work done on the improvement during the year.

PRESENT CONDITION OF THE IMPROVEMENT.

Considering their age, the dikes are generally in fair condition, with the following exceptions: The outer end of the north dike, which was

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damaged by collision with one of the large steamers plying in the harbor, which carried away a portion of the rack of fender piles and about 25 feet of the front of the pile dike; about 50 feet of the channel face of the branch dike, where the piling and timber have been broken by the heavy ice at the time of the breaking up in the spring of 1896; about 400 feet of the north end of the same dike, where the old timber is almost entirely gone on the channel face and the stone filling has settled considerably; about 300 feet of the south dike, where the stone filling has settled; and a small break in the single-pile dike connecting the south dike with the crib dock, which was made by a drifting canal boat in the spring of 1896.

The channel, dredged to 14 feet deep at mean low water, had at the time of the last examination (November 14, 1896) a depth of 14 feet, with at least 40 feet width; the 12-foot channel was 90 feet wide, and the 10-foot channel 175 feet wide. These results show a material deepening of water since the survey of 1895.

PROPOSED OPERATIONS.

The approved project for this work is completed, but frequent repairs of the dikes and probably some extension of the south dike and occasional dredging will be required.

It is proposed to make the necessary repairs to the dikes where the breaks have occurred and to refill the sections with stone where it has settled.

Rondout Harbor, New York, is in the collection district of New York. The nearest light-house is at the harbor entrance, and the nearest work of defense is Fort Columbus, New York Harbor.

Money statement.

July 1, 1896, balance unexpended	$4,827.58
June 30, 1897, amount expended during fiscal year	35.72
July 1, 1897, balance unexpended	4,791.86
Amount (estimated) required for completion of existing project	7,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	7,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

Appropriations for improving harbor at Rondout, N. Y., have been made as follows:

Application.	Date.	Amount.
Beginning north dike	June 12, 1872	$10,000.00
Completing north dike, beginning branch dike, and repairs	Mar. 3, 1873	20,000.00
Repairs		a 762.18
		b 237.82
Completing branch dike, beginning south dike, and repairs	Aug. 14, 1876	30,000.00
Completing south dike, dredging, and repairs	June 15, 1878	30,000.00
Repairing dikes	Aug. 2, 1882	2,000.00
Do	July 5, 1884	1,000.00
Do	Aug. 5, 1886	2,500.00
Do	Aug. 11, 1888	5,000.00
Do	Sep. 19, 1890	5,000.00
Do	July 13, 1892	5,000.00
Do	Aug. 17, 1894	5,000.00
Not yet expended	June 3, 1896	2,500.00
Total		119,000.00

a Allotment June 8, 1875, from appropriation for repairs of harbors on Atlantic coast.
b Allotment June 8, 1875, from contingencies of rivers and harbors.

Amount expended to June 30, 1897, $114,208.14.

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COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
General merchandise	900,000	$38,450,000
Coal	380,250	1,550,000
Brick	290,000	715,000
Building stone	210,300	2,300,000
Cement, lime, sand	512,500	3,100,000
Ice	40,000	50,000
Total	2,333,050	46,165,000

In addition to the above, the regular steamers carry over 150,000 passengers annually.

The maximum draft of vessels using the harbor is 15 feet; maximum cargo, 600 tons.

The above figures show an increase in tonnage of freights of 262,550 tons over 1895.

No new lines of transportation are reported established since July 1, 1896.

E 4.

IMPROVEMENT OF HARBOR AT PEEKSKILL, NEW YORK.

This harbor is a prominent indentation on the eastern shore of the Hudson River at Peekskill. It has an area of about 1 square mile east of the 12-foot curve of the river, and the outlying flats, 3,500 feet wide, have a maximum depth over them of 5 feet at mean low water. A narrow channel, 6 feet deep at mean low water, follows the line of the shore from north to south past the town wharves and enables steamboats and small craft to transport by water a part of the commerce originating at the town.

The river and harbor act of August 2, 1882, provided for an examination of the harbor with a view to improvement. Plans and estimates were embodied in a report dated November 28, 1883. (Annual Report of the Chief of Engineers, 1884, part 1, pp. 718–720.) It was stated in that report that "the inhabitants desire to have a channel 10,000 feet in length, from 10 to 12 feet in depth at mean low water, made through the shoals to extend from their wharves nearly parallel with the shore line up and down stream, and to communicate at both ends with the deep river channel." The estimated cost to afford 10 feet depth at mean low water was $50,000.

The river and harbor act of August 18, 1888, in the item making appropriation for continuing the Hudson River improvement, provided for the discretionary application of $10,000 toward the improvement of Peekskill Harbor. In view of the necessities of the Hudson River work, then very great, none of the money appropriated by the act of 1888 was applied at Peekskill Harbor.

The river and harbor act of August 17, 1894, provided for a further examination of Peekskill Harbor, and the report thereon, submitted December 1, 1894, stated that the harbor of Peekskill is "worthy of improvement in so far as relates to the excavation of a channel along the entire wharf front, connecting north and south with the deep-water channel of the Hudson River, excluding any work of construction upon the outlying flats."

The river and harbor act of June 3, 1896, appropriated $10,000 for improving this harbor in accordance with report submitted December 1, 1894.

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WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

A project for the expenditure of $10,000 appropriated by act of June 3, 1896, was approved by the Chief of Engineers July 28. It provided for dredging turning basins, 200 feet by 150 feet, in front of the center and lower wharves, connecting these basins by a channel 100 feet wide and 600 feet long, and connecting the basin in front of lower wharf with the deep water of the Hudson by a channel 3,500 feet long and 75 feet wide, the depth to be 9 feet at mean low water.

After advertisement a contract was made with Edgar M. Payn, dated February 9, 1897, for removing 60,000 cubic yards, more or less, of material at 13.7 cents per cubic yard. On application of the local authorities of Peekskill to extend the limits of the dredging under the contract, supplementary articles of agreement were approved by the Secretary of War May 21, providing that the channel limits be extended 600 feet north of the center wharf to the upper wharf.

Dredging under the contract was begun April 3 and completed June 12, at which date 64,620 cubic yards of material had been removed. The basins in front of center and lower wharves and the channel connecting them have been completed to the full projected width and depth, and the channel connecting the basin in front of lower wharf with the main channel of the Hudson River has been dredged to the required depth of 9 feet with a width of 100 feet, and a channel 80 feet wide and 9 feet deep has been dredged from the basin in front of center wharf north to the upper wharf.

Work has been suspended on account of the exhaustion of funds. To complete the channel as originally projected in the detailed report of November, 1883, viz, to 10 feet depth with a width of 100 feet, will require an appropriation of about $40,000, of which the sum of $20,000 is recommended for expenditure in the fiscal year ending June 30, 1899.

Peekskill Harbor is in the collection district of New York. The nearest works of defense are situated upon Governors Island, New York Harbor, and the nearest lighthouse is Stony Point Light.

Money statement.

July 1, 1896, balance unexpended	$10,000.00
June 30, 1897, amount expended during fiscal year	9,796.30
July 1, 1897, balance unexpended	203.70
Amount (estimated) required for completion of existing project	40,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

AMOUNT APPROPRIATED.

Act June 3, 1896	$10,000.00
Amount expended to June 30, 1897	9,796.30

Abstract of proposals for dredging in Peekskill Harbor, New York, received in response to advertisement dated November 30, 1896, and opened January 5, 1897, by Col. G. L. Gillespie, Corps of Engineers.

No.	Name of bidder.	Dredging in Peekskill Harbor, New York, 60,000 cubic yards (more or less). Per cubic yard.	Amount.	Remarks.
1	Edgar M. Payn	$0.13 7/10	$8,220.00	Lowest bid.
2	Alonzo E. Smith	.15	9,000.00	
3	John P. Randerson	.28	16,800.00	If bulkhead required.
		.14 1/2	8,700.00	
4	P. W. Myers & Son	.23	13,800.00	
5	Newburgh Dredging Co	.31	18,600.00	

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CONTRACT IN FORCE.

With Edgar M. Payn, dated February 9, 1897, approved by the Chief of Engineers February 16, 1897, for dredging 60,000 cubic yards of material, at 13.7 cents per cubic yard; work to begin April 1, 1897; completed June 12, 1897.

Supplementary contract with Edgar M. Payn, dated May 7, 1897, for extending northerly limit of dredging 600 feet.

COMMERCIAL STATISTICS.

The following statistics for 1894 and 1897, were furnished by the Peekskill Board of Trade:

	1894.		1897.	
	Shipped and received.	Value.	Shipped and received.	Value.
	Tons.		*Tons.*	
Hat factory	25,000	$1,000,000	25,000	$1,000,000
A. Clark (stone)	1,000	10,000	1,000	10,000
John McGovern (stone)	500	5,000	500	5,000
John Smith, jr (gravel and felt)	1,000	50,000	2,000	100,000
Pennsylvania Emery Works	7,000	75,000	7,000	75,000
R. MacKellar Sons (plaster mills)	1,500	20,000	1,500	20,000
Peekskill Gas Works	2,000	25,000	2,500	30,000
Oilcloth factory	15,150	400,000	20,000	500,000
Union Stove Works (iron foundry)	20,000	600,000	20,000	600,000
Southard, Robertson & Co. (iron foundry)	12,000	400,000	12,000	400,000
Peekskill Stove Works (iron foundry)	10,000	350,000	10,000	350,000
Ely & Ramsay Co. (iron foundry)	10,100	340,000	10,100	340,000
Star Foundry Co. (iron foundry)	7,000	150,000	7,000	150,000
G. W. Bagley (steam flour and grain mill)	5,530	110,000	6,000	115,000
Seymour Bros. (coal and wood)	5,275	100,000	3,000	60,000
Naylor Bros. (machine works)	10,000	200,000	10,000	200,000
New York Stove Works	10,200	400,000	10,200	400,000
Anderson Machine Works	2,000	50,000	2,000	50,000
Anderson Electric Works	200	15,000	200	15,000
H. L. Armstrong (coal)	25,000	250,000	3,500	250,000
Andrew Wood (coal and wood)	5,000	100,000	5,000	50,000
Horton & Mabie (fire brick)	4,200	125,000	4,200	125,000
Osborn Ship Yard	1,000	100,000	2,000	20,000
N. Dain Sons (lumber)	22,000	200,000	30,000	300,000
M. E. Clinton (lumber)	1,500	100,000	1,500	100,000
St. Joseph's Home	6,000	250,000	7,000	350,000
St. Mary's Home	1,000	200,000	3,000	35,000
Peekskill Waterworks	4,000	250,000	5,000	300,000
Baker Underwear Factory	2,000	80,000	4,000	160,000
Maxwell Shirt Factory	800	20,000	800	20,000
Emery Works	500	5,000	500	5,000
C. W. & R. W. Oldfield (brick yard)	8,000	124,000	8,000	124,000
Bonner Brick Co.	8,000	120,000	8,000	120,000
I. Hearne (stone)	500	5,000	.....	.....
E. Lockwood (paper mill)	10,000	50,000	.....	.....
I. J. Baxter (iron works)	5,000	15,000	.....	.....
C. W. Ellison (flour, feed, and grain)	3,500	7,000	.....	.....
Chapman Bros. (lumber)	1,000	25,000	.....	.....
Harrison's Pottery	1,000	5,000	.....	.....
Bonner & Cole (brick)	9,000	122,500	.....	.....
Ale and lager beer	3,500	80,000	5,000	50,000
Molding sand	225,000	150,000	225,000	150,000
Wood	15,000	40,000	15,000	40,000
Limestone	15,000	15,000	15,000	15,000
Patrick Donohue (bluestone)	.....	.....	1,000	10,000
Chauncey Horton (flour, feed, and grain)	.....	.....	3,500	70,000
Geo. F. Cooley (flour, feed, and grain)	.....	.....	3,500	70,000
Dayton Bros. (coal)	.....	.....	5,000	20,000
Chas. H. Chase (sash, doors, mantels, etc.)	.....	.....	2,000	40,000
Chas. A. Samos	.....	.....	2,500	50,000
Asbury Barker (building materials)	.....	.....	3,000	60,000
Hopkins Bros. (building materials)	.....	.....	1,000	20,000
F. K. Roe (ice)	.....	.....	10,000	30,000
Peekskill Military Academy	.....	.....	2,000	20,000
Lake Mohegan Military Academy	.....	.....	1,000	10,000
New York State military camp	.....	.....	20,000	100,000
	522,955	6,688,500	546,000	7,134,000
10 steamboats, 2 freight boats, and 910 sailing and other craft; passengers carried, 64,000	523,000	14,000,000	.....	.....
10 steamboats, 3 freight boats, and over 900 sailing and other craft; passengers carried, 64,000	.....	.....	500,000	.....

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E 5.

IMPROVEMENT OF HARLEM RIVER, NEW YORK.

The project for making a navigable connection between the East River and the Hudson River, by way of the Harlem River and Spuyten Duyvil Creek, was based upon the facts determined by the survey made along this route in 1874 in compliance with the river and harbor act of June 23, 1874, the report upon which may be found on page 224, Annual Report of the Chief of Engineers for 1875, part 2.

This report contains an interesting historical review of the navigation of the Harlem River from the Revolution to the present time.

A history of this improvement, with the legal proceedings for the acquirement of the land needed for it and copies of the laws passed by the legislature of the State of New York relative thereto, are given in the annual report of the engineer in charge to the Chief of Engineers for 1887. (See Annual Report of the Chief of Engineers for 1887, part 1, pp. 665–689.)

The streams embraced in the improvement are the Harlem River and Spuyten Duyvil Creek, the former emptying into the East River near Hell Gate and the latter into the Hudson River about 13 miles north of the Battery, and the two separating Manhattan Island from the mainland.

There has always been an exchange of waters between these two streams at Kings Bridge, although a long ledge of rocks awash at mean low water and a very narrow channel at that point prevented the exchange being a free one.

High Bridge was originally the head of navigation in the Harlem River, but there was a fair channel of about 10 feet depth at mean low water as far as Morris Dock, 6 miles from the mouth of the river, and a crooked one of 7 feet depth to Fordham Landing, 1 mile farther. There was no navigation of this upper section, except by rowboats or by small boats used for transporting building material to the "Annexed District." Kings Bridge, 1¾ miles from the Hudson River, was the head of navigation in Spuyten Duyvil Creek, but only at high water for vessels drawing 8 feet or less.

The range of the tides in Harlem River varied from 5.5 feet at Third Avenue Bridge to 6 feet at the mouth of Dyckman Creek, and in the Spuyten Duyvil Creek was 3.8 feet.

As the difference in the height and times of tides in the East and Hudson rivers, after connection between the Harlem and the Hudson rivers, would produce the currents needed to keep the channel open, it was desirable that the cross section be made as uniform as possible in order to avoid the resistance to the flow of the water which would be caused by any unnecessary contraction of the water way.

Comparative observations of the tides in 1874–1876, prior to the improvement, showed that there was practically a divide somewhere near Fordham Bridge between the tides flowing from the East River into the Harlem and from the Hudson River into Spuyten Duyvil Creek. Comparing the tides of the Harlem at Fordham Bridge with those of the Hudson at the mouth of Spuyten Duyvil it was found:

(1) That the level of mean high water in the Hudson was nearly 1 foot (0.961 foot) lower than it was in the Harlem at Fordham Bridge.

(2) That the mean range of the tide in the Hudson was 2.12 feet less than at Fordham.

(3) That the mean duration of the rise of tides in the Hudson was thirty-six minutes shorter and the mean duration of the fall twenty-six minutes longer than in the Harlem.

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(4) That the mean level of the Hudson at the mouth of Spuyten Duyvil Creek was 0.265 of a foot lower than at Fordham Bridge.

(5) That high water occurred one hour and thirty-four minutes earlier in the Hudson than in the Harlem.

From these facts it followed that while on the opening of the new channel through Dyckman Meadow near Fordham Bridge there would be a free flow in either direction, depending upon the relative stage of the tides, the preponderance would be westward, and the mouth of the improved channel would then be at the junction with the Hudson River.

The final project for the improvement was adopted in 1879. The proposed channel lines as laid down by the engineer in charge in his annual report for 1882 are as follows:

(1) Below the Harlem or Third Avenue Bridge the outer pier and bulkhead lines as laid down by the park department were adopted.

(2) Above the Third Avenue Bridge to the entrance of Dyckman Creek into the Harlem River the exterior pier and bulkhead lines were laid down 400 feet apart.

(3) The line following Dyckman Creek through Dyckman Meadow passed for a part of the way through solid rock, and it is here that the principal cost of the undertaking was encountered. This part to be made 350 feet wide. It would be preferable to establish it at 400 feet, but the large additional amount of rock excavation was the objection, and the depth was increased instead.

(4) The remainder of the line to the Hudson River to follow, as nearly as possible, the course of Spuyten Duyvil Creek, with a width of 400 feet.

(5) The channel depth in the Harlem and Spuyten Duyvil to be 15 feet at mean low water, and in the rock cut along Dyckman Creek 18 feet.

The cost of opening the water way from the Hudson to the Harlem at East Two hundred and eighteenth street, New York City, was estimated in 1875 at $2,100,000, and for dredging the Harlem thence to Third avenue $600,000 additional, making the estimated aggregate cost of the improvement $2,700,000.

The project was revised in 1886 by narrowing the channel immediately north of High Bridge to 375 feet where it skirts the Ogden estate on the east bank. (See Annual Report of the Chief of Engineers for 1887, part 1, p. 671.)

The legal difficulties in acquiring the right of way along the line of the proposed work were removed in May, 1887, and immediately thereupon the appropriations of 1878 and 1879, aggregating $400,000, became available, and the project for their expenditure was begun and has continued under succeeding appropriations.

By act of Congress approved March 3, 1881, a survey was made of the Harlem or Bronx Kills, north of Randall Island, and a report was submitted upon the practicability of opening a channel 300 feet wide and 15 feet deep, mean low water, between the East River and the Harlem River by this route. The report will be found in the Annual Report of the Chief of Engineers for 1882, part 1, page 656. No appropriation has been made for this.

Harbor lines for the preservation and protection of the navigable waters of the Harlem River and Spuyten Duyvil Creek were established by the Secretary of War October 18, 1890, under authority of the river and harbor act of August 11, 1888.

On application of the department of public parks of New York City

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a modification of the harbor lines for the west bank of the Harlem River from High Bridge to and beyond the Washington Bridge was authorized by the Secretary of War October 2, 1893.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

At the beginning of the year previous contracts had been completed and work was temporarily suspended. By the river and harbor act of June 3, 1896, $125,000 was appropriated for continuing the improvement; and a project for the expenditure of this appropriation, together with available balances, was approved by the Chief of Engineers on July 7, 1896, the work to be done partly by contract and partly by hired labor.

Sealed proposals were invited August 3, 1896, and contract was made with Rittenhouse R. Moore, the lowest responsible bidder, September 26, 1896. This contract provides for the removal, by dredging, of 413,000 cubic yards, more or less, of material from the Harlem River and Spuyten Duyvil Creek, and for the construction of about 800 linear feet of crib work revetment for the protection of the west side of the channel where it passes through the point of meadow south of Fordham Bridge.

The work contemplated to be done by hired labor, using Government plant, comprised the completion of the removal of the ledge of rock at the entrance to Mott Haven Canal, and the removal of large bowlders and other rocky obstructions likely to be uncovered in widening the existing channel through the shoals at Morris Dock, High Bridge, and McComb Dam Bridge. The project also provides for the construction of about 40 linear feet of stone revetment wall on the north side of Dyckman Cut, west of Broadway, contract for which has not yet been let.

Dredging operations under the contract with Rittenhouse R. Moore, were begun November 30, 1896, and continued to the close of December, when work was suspended, owing to unfavorable conditions for prosecuting work during the winter season. Operations were resumed on April 26, 1897, and are still in progress.

The work of removing rocky obstructions in the lower Harlem River, by hired labor and use of Government plant, was resumed on March 10 and is still in progress.

During the fiscal year the following work was done under the foregoing contract, and by hired labor, with use of Government plant:

Locality.	Contract quantity.	Removed during fiscal year.
Under contract dated September 26, 1896—dredging:	*Cub. yds.*	*Cub. yds.*
From Spuyten Duyvil Creek and Harlem River	383,000	92,102
From shoals at Morris Dock, High Bridge, and McComb Dam Bridge	30,000	.....

REMOVAL OF THE ROCKY LEDGE AT THE ENTRANCE TO MOTT HAVEN CANAL.

Operations for the removal of this ledge were first begun October 15, 1895, and on March 23, 1896, when work was suspended owing to the exhaustion of funds available for the work, 980 tons of rock had been excavated from the ledge, and a general depth of about 12 feet, mean low water, had been obtained over nearly the entire area of the reef, the original depth being 6 feet, mean low water; no further work was done until March 10, 1897, when a chartered dredge of the dipper type was

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put to work to excavate stone broken up by former drilling and blasting operations, and which the grapple dredge owned by the Government had failed to raise. After all loose material covering the ledge had been removed as far as possible, the drill scow *Hudson*, which had undergone necessary repairs during the winter season, resumed drilling and blasting operations on such points of the reef as still had less than the required depth of 15 feet, mean low water, over them; and at the close of the fiscal year a total of 1,552 additional tons of rock had been removed from the ledge, making a total of 2,532 tons removed to date, and a general depth of 14 feet had been obtained over nearly the entire area of the reef. Of the material removed during the year 1,300 tons was raised by the dredge, working a total of 10 days, and the remainder, consisting mostly of large pieces of stone, was chained by diver and raised by the appliances on the drill scow.

In the operations for the removal of the reef a total of 196 holes were drilled and 1,106 pounds of forcite were expended in breaking up the rock. The total cost per ton for all material removed to date is $3.42.

The improved channel, which at the beginning of the year had a depth of 12 feet, mean low water, with a minimum width of 150 feet from the Hudson River to Macomb Dam Bridge, was by the operations of the fiscal year widened so as to afford a navigable channel 12 feet deep, mean low water, nowhere less than 200 feet wide from the Hudson River to the east end of Dyckman Cut, and thence 150 to 180 feet wide to Macomb Dam Bridge at One hundred and fifty-fifth street. From this point south to Wards Island, East River, the available channel is 15 feet deep and over, and nowhere less than 150 feet wide.

The results of observations made in the spring of 1896 to determine the tidal and current changes in the Harlem River due to establishing open communication between the waters of the Hudson and East rivers, through the limited channels thus far obtained, may be found in the Annual Report of the Chief of Engineers for 1896, page 848.

This improvement can not be well or economically conducted except under liberal appropriations. The amount that can be profitably expended during the fiscal year ending June 30, 1899, is $500,000.

A full statement of the commerce likely to be benefited by improvement is subjoined.

Mr. A. Doerflinger, assistant engineer, has been in local charge of this improvement during the year and has discharged his duties with his accustomed fidelity and efficiency.

Harlem River is in the collection district of New York. The nearest light-house is Hell Gate.

Money statement.

July 1, 1896, balance unexpended		$151,677.04
June 30, 1897, amount expended during fiscal year		37,917.70
July 1, 1897, balance unexpended		113,759.34
July 1, 1897, outstanding liabilities	$10,191.45	
July 1, 1897, amount covered by uncompleted contracts	66,730.21	
		76,921.66
July 1, 1897, balance available		36,837.68
Amount (estimated) required for completion of existing project		1,555,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		500,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

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AMOUNTS APPROPRIATED.

Allotment June 23, 1874, from appropriations for East and Harlem rivers.	$11,000.00
Act of March 13, 1875	10,000.00
Total	21,000.00

AMOUNTS APPROPRIATED UNDER PRESENT PROJECT.

June 16, 1878	300,000.00
March 3, 1879	100,000.00
August 11, 1888	70,000.00
September 19, 1890	250,000.00
July 13, 1892	175,000.00
August 17, 1894	125,000.00
June 3, 1896	125,000.00
Total	1,145,000.00
Amount expended to June 30, 1897	1,031,240.66

Abstract of proposals for improving Harlem River, New York, received in response to advertisement dated August 3, 1896, and opened September 10, 1896, by Col. G. L. Gillespie, Corps of Engineers.

Materials, etc.	1. P. Sanford Ross.		2. Rittenhouse R. Moore.	
	Per unit.	Amount.	Per unit.	Amount.
Dredging in Spuyten Duyvil Creek and Harlem River, 383,000 cubic yards.....cubic yard..	$0.15 3/10	$58,599.00	$0.14½	$55,535.00
Dredging at Morris Dock, High Bridge, and McComb Dam Bridge, 30,000 cubic yards.....cubic yard..	.25	7,500.00	.20	6,000.00
Crib-work revetment, 355,000 cubic feet.....cubic foot..	.01¼	4,437.50	.01½	5,325.00
Round timber for crib-work revetment, 115,000 linear feet, linear foot	.05¼	6,037.50	.04½	5,175.00
Square timber, 67,000 feet, B. M.....1,000 feet, B. M..	32.00	2,144.00	26.00	1,876.00
Iron driftbolts, spikes, etc., 44,000 pounds.....pound..	.02¼	990.00	.04	1,760.00
Oak fenders, half round, 370 pieces.....per piece..	3.00	1,110.00	.95	351.50
Stone filling, furnished by contractor, 8,000 cubic yards, cubic yard	.40	3,200.00	.50	4,000.00
Stone filling, Government stone used, 8,000 cubic yards, cubic yard	.40	3,200.00	.90	7,200.00
Total	.....	84,018.00	.....	{a 80,022.50 / 83,222.50

a Using contractor's stone; lowest bid.

CONTRACT IN FORCE.

With Rittenhouse R. Moore, dated September 26, 1896, approved by the Chief of Engineers October 20, 1896, for dredging 413,000 cubic yards of material from Harlem River and Spuyten Duyvil Creek, and for constructing 800 linear feet of crib-work revetment; work to begin November 1, 1896, and to be completed June 30, 1898.

COMMERCIAL STATISTICS.

The actual commerce of the Harlem River and Spuyten Duyvil Creek for the years 1893 and 1895 was as follows:

Items.	1893 (tons).	1895.	
		Tons.	Value.
General merchandise	3,232,052	3,473,581	$171,803,633
Grain, flour, feed, etc	596,306	767,851	15,238,420
Lumber and timber	451,702	633,194	7,839,116
Building material	602,217	1,526,043	4,698,294
Fuel	878,234	947,710	3,776,483
Ice	149,865	185,215	351,430
Total	5,910,376	7,533,594	203,707,376

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The total tonnage for the year 1895 shows an increase over that of 1893 of 1,623,318 tons, or nearly 28 per cent during the two years. Of the total tonnage 4,022,832 tons was received and shipped at the docks of the New York, New Haven and Hartford Railroad Company directly below Second Avenue Bridge, where also about 62,000 passengers were transferred in cars by the steamer *Maryland* to and from the New York, New Haven and Hartford Railroad to and from connecting lines terminating on the Hudson River at Jersey City. Of the balance, 28,101 tons was handled at various points on Spuyten Duyvil Creek, and 3,482,661 tons was received and shipped at the various docks on the Harlem River between its junction with the East River and Dyckman Cut.

As near as can be determined, the vessels engaged in the river traffic were as follows:

Canal boats, barges, and railroad-car floats	37,246
Sailing vessels, schooners, lighters, etc	5,483
Steamers and tugs, exclusive of pleasure boats	27,525

A large proportion of the freight handled at the docks of the New York, New Haven and Hartford Railroad Company is carried in and out of the Harlem River on railroad-car floats and transfer boats; and during the year 1895 335,236 loaded cars and 155,757 empty cars were thus received and shipped from these docks. Only the contents of these cars are included in the above tonnage, not the weight of the cars themselves.

There was also carried out of the river, on scows, 142,650 tons of ashes and other city refuse, which is not included in the above table.

BRIDGES ACROSS THE HARLEM RIVER.

The following table shows the location and characteristics of the several existing bridges across the Harlem River:

Name and location of bridge.	Width in clear in each draw.	Height of bottom chords above mean high water.	Remarks.
	Feet.	*Feet.*	
Second avenue	103.7	28.5	Double draw, railroad bridge, iron.
Third avenue (temporary)	61	4	Double draw, wooden trestle, iron drawspan.
Fourth avenue (temporary)	60	1	Single draw, wooden trestle, iron drawspan in process of removal.
Fourth avenue (permanent)	102	25.6	Double draw, railroad bridge, iron.
Madison avenue	132	25	Double draw, road bridge, iron.
Macomb dam, One hundred and fifty-fifth street.	164	28	Do.
Macomb dam, One hundred and fifty-sixth street (temporary).	76	16.7	Double draw, road bridge, wood. Order for removal within 90 days served by the Secretary of War on president of park board on April 12, 1897.
New York and Northern Railway Bridge, at Eighth avenue.	128	28	Double draw, railroad bridge, iron.
High Bridge (old aqueduct)	.....	.....	No draw; stone arch; width between piers, 77.7 feet; clear waterway, 55 feet; crown of arch, 100 feet above mean high water.
Washington Bridge, at One hundred and eighty-first street.	.....	Single span.	No draw; iron arch; span, 500 feet; clear waterway, 420 feet; crown of arch, 136.7 feet above mean high water.
Farmers Bridge	.....	3.1	No draw; two spans, 22 and 23 feet wide; light timber structure.
Kingsbridge	.....	4.8	No draw; two spans, 18 and 25 feet wide.
Bridge at Broadway, across improved channel.	104	26	Double draw, road bridge, iron; opened to traffic January 1, 1895.
Hudson River Railroad Bridge, at mouth of Spuyten Duyvil Creek.	50	6.9	Single draw, wooden trestle, iron drawspan; will shortly be replaced by iron truss bridge with double drawspan.

To comply with the requirements contained in the river and harbor act passed June 3, 1896, rules and regulations for the opening and operating of the draws in the bridges crossing the Harlem River were prescribed by the Secretary of War on October 31, 1896.

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BRIDGES AFFECTED BY STATE ACTS, OR BY NOTICES SERVED BY THE SECRETARY OF WAR.

1. Bridge at First avenue, New York City.—An act of the legislature of the State of New York, to provide for the construction of a bridge across the Harlem River from First avenue to Willis avenue, was approved by the governor on March 21, 1894.

Plans for the construction of this bridge, conforming to the general provisions of the State act of 1879, as to height of lower chord and length of spans, prepared by the department of public parks of New York City, received the approval of the Secretary of War on January 11, 1895, but work of construction has not yet been begun

2. Bridges at Third and Fourth avenues.—The city of New York, owning or controlling the bridge at Third avenue, and the New York Central and Hudson River Railroad Company, owning or controlling the bridge at Fourth avenue, were notified by the Secretary of War July 2, 1890, to modify these bridges in accordance with the recommendations of The Board of Engineers convened May 7, 1890, to consider, as stated in the Annual Report for 1890, the matter of bridges across the Harlem River at Third and Fourth avenues, New York City. These notices required that the modifications called for should be completed by January 1, 1892.

The legislature of the State of New York, by act approved April 5, 1892, authorized and required an increased elevation of the Fourth Avenue Bridge, and provided for all changes in any avenues, streets, and railroads that may be necessary by reason of such increased elevation. A commission to carry out the provisions of this act was appointed by the mayor of New York City April 25, 1892. This act enabled the railroad company to reconstruct the bridge in conformity with the requirements of the notice of the Secretary of War, which in the absence of the necessary legislative action the company had not theretofore been able to carry out. Plans for the new bridge received the approval of the Secretary of War August 5, 1892.

In order that the traffic across the river might not be suspended while the permanent bridge is in process of construction, the railroad company applied to the Secretary of War for authority to build a temporary bridge, provided with a 60-foot draw, and situated 160 feet to the northward of the old bridge. This application was granted May 27, 1892. The railroad company began the work of modification in September, 1892, and at the close of the fiscal year the old bridge had been removed and the traffic of the road diverted to the temporary bridge.

The new bridge was completed and opened to traffic on February 15, 1897, and the New York Central and Hudson River Railroad Company were requested to remove the temporary bridge on March 2, 1897, and work on the removal of the structure is now in progress.

An act to provide for the reconstruction of the Third Avenue Bridge was approved by the governor of the State of New York May 2, 1892, and plans for the construction of the new bridge, prepared by the department of public works of New York City, received the approval of the Secretary of War March 24, 1893.

The work of modification began in November, 1893, and at the close of the year the old bridge had been removed and the traffic across the river had been diverted to the temporary bridge.

The masonry of the pivot pier, the two rest piers, and the south abutment and Lexington avenue approach is completed, the ironwork of the drawspan is erected, and work is in progress on the north abutment and on the Third avenue approach on the north side of the river.

Temporary bridge at One hundred and fifty-sixth street: Authorized by revocable license of the Secretary of War, dated July 5, 1892, and expiring May 1, 1895, date of completion of permanent bridge at One hundred and fifty-fifth street. The department of public parks, New York City, was requested May 5, 1895, to remove the temporary bridge, which request was repeated February 26, 1897. An order of the Secretary of War to remove the bridge within three months was served on the president of the park board on April 12, 1897, but up to the present time nothing has been done on its removal.

3. Bridge at mouth of Spuyten Duyvil Creek.—Plans for the reconstruction of the old railroad bridge at this site were submitted to this office by the New York Central and Hudson River Railroad Company, May 31, 1894, for transmittal to the Secretary of War. These plans, which received the approval of the Secretary of War August 28, 1894, provide for the reconstruction of the bridge with a clear waterway of 105 feet in each draw opening, and with the lower chord of bridge placed at the height of 4½ feet, approximately, above mean high water.

The work of reconstruction has not yet been begun.

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E 6.

IMPROVEMENT OF EAST RIVER AND HELL GATE, NEW YORK.

East River is the designation of the narrow tidal strait which connects New York Harbor with Long Island Sound. It forms a commercial entrance secondary in importance only to the main entrance via Sandy Hook and the Narrows, as the heavy coasting trade carried on by New York and the New England States and the British American Provinces uses it almost exclusively.

The population now bordering New York Harbor numbers 3,000,000 or more, and should the present rate of increase be maintained for half a century longer, the population would be about 8,000,000. The development of the water fronts along the Hudson and East rivers must therefore be certain and rapid, and with this development the importance of the East River entrance will increase greatly. It seems not unreasonable to predict that within the next fifty years the shore line on both sides of the East River within 15 miles of Harlem River and Hell Gate will be occupied by shipping engaged in the local, coasting, and transatlantic trade.

The East River is crooked and narrow, much obstructed by rocks and reefs, and traversed by powerful tidal currents.

The worst of these obstructions originally was that known as Hell Gate, between Blackwells and Wards islands, about opposite Ninety-sixth street, New York. Here the river turns at right angles around Hallets Point, divides into several channels, and runs with a velocity varying at different stages of the tide from 3 to 10 miles an hour over or around Hallets Point, Negro Point, Ways Reef, Shell Drake, Pot Rock, Frying Pan, Heel Tap, Holmes Rock, Hog Back, Flood Rock, Hen and Chickens, Gridiron, the Negro Heads, Mill Rocks, Rhinelanders Reef, and Bread and Cheese.

On account of the violence and irregularities of the currents and the crowded condition of this passage, wrecks at Hell Gate were numerous prior to 1867. At that time some of these rocks projected above the water level, while the least depth over others at mean low water varied from 0 to 20 feet. In conformity with the provisions of the act approved June 23, 1866, examination was made of Hell Gate with a view to its improvement, and three separate projects were submitted January 21, 1867, to afford channels of 26 and 24 feet in depth at mean low water. The project adopted in 1867 (Annual Report of the Chief of Engineers for 1868, p. 741) provided for the removal of the rocks and reefs in the channel to a depth of 26 feet at mean low water, and for the building of sea walls and dikes upon others bordering the channel to guide the currents so that vessels might pass in safety. The cost of the project was estimated at $8,692,645.15. The removal of Hallets Point was begun in 1869 and the final blast made September 24, 1876. A new estimate was made January 3, 1870, "based upon the process of tunneling the larger reefs, such as Hallets Point and the Middle Reef, and removing the smaller reefs by drilling from the surface of the water," and the cost was placed at $4,689,820.

The estimate was again revised in 1874 to include the removal of Diamond and Coenties reefs, near the lower end of Manhattan Island (Annual Report of the Chief of Engineers for 1874, part 2, p. 164), and the total cost fixed at $5,139,120. It provided for the removal at Hell Gate to a depth of 26 feet, mean low water, of the reefs at Hallets Point, Ways Reef, Shell Drake, Pot Rock, Frying Pan, Heel Tap,

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Negro Point, and Flood Rock, including the Gridiron, Hen and Chickens, and Negro Heads, and the construction of a dike to connect the Mill Rocks and sea walls upon Hog Back and Holmes Rock, and in other parts of the East River for the removal of Diamond Reef and North Brothers Island Reef to a depth of 26 feet, Coenties Reef to a depth of 25½ feet, and the small rocks known as Scaly Rocks, Blackwells Rock, and the rock off Woolsey's bath house.

The work of mining Flood Rock began in June, 1875.

In 1880 part of the débris arising from the excavation of the tunnels in Flood Rock was deposited in the unused channels between Great and Little Mill rocks, and a dike, with its crown rising above mean high water, was formed as a training wall for the currents through the Gate. This dike was utilized later as a place for the storage of public material and the berthing of plant used upon the improvement.

In 1882 a protection wall was built by the city of New York upon the reef locally known as "Bread and Cheese," which projects into the Gate from the eastern end of Blackwells Island.

The final blast for the demolition of Flood Rock was fired October 10, 1885, since which date large dredges have been employed to raise the stone broken by the explosion.

The project was enlarged in 1884 to include the removal of Pilgrim Rock, off Nineteenth street, to 24 feet mean low water, and again in 1889 to include the removal of the reef off Diamond Reef, Ferry Reef off Thirty-fourth street, and Charlotte Rock, northwest of entrance to Newtown Creek, to 26 feet mean low water; work to be done by hired labor with drill scow.

A steam drill scow fitted with a movable iron dome working within a central well was put in operation in the winter of 1870–71 for the removal of submerged reefs. Its results have been most satisfactory, as by its use rocks covered by the swift currents of the East River are economically drilled and blasted.

The stone broken by the blasts is sometimes removed by appliances attached to the scow, but generally by the Government dredge employed at Hell Gate.

At the close of the fiscal year ending June 30, 1896, the following parts of this project had been executed: Hallets Point, covering 3 acres; Way Reefs, Shell Drake, Diamond Reef, North Brothers Island Reef, Coenties Reef, reef off Diamond Reef, Barretto Reef, and Scaly Rock had been removed to the projected depth. Pilgrim Rock and Ferry Reef had been reduced to a least depth of 24 feet; Heel Tap had been broken to 26 feet and dredged to 20.5 feet, and the least depths on Frying Pan and Pot Rock were 18 feet and 22.8 feet at mean low water, respectively. Flood Rock and connecting reefs, covering 9 acres, had been broken to 30 feet, and 204,015 tons of débris had been removed. The least depth over Flood Rock, Hen and Chickens, and Gridiron was 20 feet at mean low water, and in the channel between Flood Rock and the Mill Rocks 18 feet. Shell Reef, off Ninth street, had been reduced to 18 feet, except at a few points. The reef off Sunken Meadow, which originally had only 11 feet over it, had been lowered to 16 feet, mean low water, over the main reef, and to 18 feet on the southern half.

Hell Gate and vicinity included the most dangerous obstructions in the East River; but there are rocks and reefs in other parts of this crowded waterway which are constant sources of danger, have caused many casualties, and should be removed.

Prominent among these is the long series of reefs and isolated rocks in midstream, extending 1½ miles southward and westward from the

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foot of Blackwells Island, which have always been troublesome to vessels crossing from one channel to the other, as the winds and tides often compel them to do, and which, with the continually increasing size of vessels and the increasing commerce of the river, are becoming still more dangerous. The Man-of-War Rock, marked by a spindle, opposite Thirty-eighth street, is a prominent part of this reef.

A second serious obstruction is Middle Ground, situated in mid-channel 1½ miles to the eastward of Hell Gate, near the southern entrance to Little Hell Gate, between Sunken Meadows and Lawrence Point, with a channel on either side of barely 350 feet width. The reduction of this reef to 18 feet mean low water is in progress.

Still farther eastward are the obstructions and sharp turns in the vicinity of the North and South Brother Islands. Lower down the East River are numerous areas over which the existing depth is insufficient for sea-going vessels, and in course of time must be deepened as the appropriations may be continued and work at other points be completed.

In fact, the increasing draft and tonnage of vessels indicate that a revision of the ruling depths to which the navigation should be improved will be needful even in the case of localities already deepened.

The suit begun by private parties to dispossess the United States of its occupancy of the dike built by it between Great and Little Mill rocks, Hell Gate, was decided by the courts in May, 1889, in favor of the United States, but appeal has been taken by the complainant to a higher court. It is important that the United States retain possession, as the ground is needed for wharfage and for repair shops for the drill scow and dredges. The old machinery and worn-out plant and material stored for many years at Hallets Point have been sold, and the office for the local charge of work has been transferred to the dike.

The plant in use on the improvement has been kept in good repair during the year.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

At the opening of the year no contracts were in force and no operations in progress, as, on account of the exhaustion of funds, the Government plant had been laid up January 4, 1896.

The river and harbor act of June 3, 1896, appropriated $60,000 for continuing the improvement.

The project for the expenditure of this sum, providing for continuing work with Government plant on Middle Ground off Sunken Meadow and at other points in the river where rocks may prove obstructive to navigation, was approved by the Chief of Engineers July 6, 1896.

REEF OFF SUNKEN MEADOW.

The U. S. steam drill scow *Gen. John Newton* and dredge *Hell Gate* resumed work on reef off Sunken Meadow August 28, and continued until December 20, when work was suspended and the plant hauled off for repairs.

At that date the rock had been broken to a depth of 18 feet at mean low water. On the completion of removal of Charlotte Rock, June 23, 1897, the tender scow with a crew of 9 men was employed on this reef in removing shoal spots lying above 18 feet. At the close of the year this work is still in progress and will be completed early in July.

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The following table shows the work done during the fiscal year, and the total to date, on reef off Sunken Meadow:

	During fiscal year.	Total to date.
Number of times dome was lowered	28	194
Number of holes drilled	124	1,065
Average depth of holes ..... feet..	7.2	7.1
Actual time running drills ..... hours..	142	981
Number of drill-hole blasts fired	25	188
Pounds of explosive used (forcite No. 2X)	4,215	46,427
Tons of broken stone raised by divers	4	664
Tons of broken stone raised by pump	.....	572
Tons of broken stone raised by dredge	2,171	13,890
Total tons raised and dumped	2,175	15,126
Total cost of work	$12,906.07	$91,377.35
Cost per ton	$5.94	$6.04

CHARLOTTE ROCK.

After completing the repairs the steam drill scow *Gen. John Newton* and dredge *Hell Gate* began operations on Charlotte Rock February 11, 1897, and completed the removal of this reef to the contemplated depth of 26 feet at mean low water.

The final sweeping on this reef was made with the horizontal bar on June 23, and the least depth anywhere over the reef is 26.5 feet at mean low water.

Charlotte Rock was a narrow ledge 100 feet wide by 250 feet long, with a least depth of 14.7 feet at mean low water, lying in the East River opposite and 2,100 feet east of Thirty-fifth street, New York City. It obstructed the channel east of Blackwells Island and was a serious menace to navigation.

The following table shows the work done on this reef, and the cost:

Number of times dome was lowered	20
Number of holes drilled	213
Average depth of holes ..... feet..	10.3
Actual time running drills ..... hours..	316
Number of drill-hole blasts fired	19
Pounds of explosive used (80 per cent forcite)	2,722
Tons of broken stone removed	7,485
Total cost of work	$18,906.21
Cost per ton of 2,240 pounds	$2.52

On the completion of removal of Charlotte Rock, June 23, 1897, operations were suspended and the plant laid up on account of exhaustion of funds.

Request of the depot quartermaster, New York City, for increased facilities and depth in the approaches to wharves at Davids Island and Willets Point, N. Y., was approved by the Chief of Engineers December 16, 1896. After advertising for sealed proposals, an agreement was made with R. G. & J. S. Packard, the lowest bidder, to dredge 12,000 cubic yards, more or less, of material from the approaches to the wharf at Davids Island, New York, and 17,500 cubic yards, more or less, of material from the approaches to the wharf at Willets Point, New York, at 11 cents per cubic yard.

Work under this agreement began January 14, 1897, and was completed on February 17, 1897; 33,148 cubic yards were removed. At Davids Island a basin 200 feet square in front of the wharf, with a channel 100 feet wide and 700 feet long to the 12-foot curve, were deepened to 12 feet at low water. At Willets Point a channel 200 feet

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wide and 1,000 feet long from the Post Wharf to the Main Channel, was dredged to 12 feet at low water, and a slip on the south side of the wharf was made 40 feet wide and 8 feet deep for a length of 150 feet.

The amount that can be profitably expended in the removal of obstructions in East River and Hell Gate during the fiscal year ending June 30, 1899, is $200,000, to be applied to the removal of Flood Rock débris and of rocky obstructions at such other points in the East River as the necessities of navigation demand, notably the unnamed rock off Twenty-sixth street, discovered in 1893.

This work is in the collection district of New York. The nearest port of entry is New York City. The nearest light is Blackwells Island light. The nearest fort is Fort Columbus, Governors Island, New York Harbor.

Money statement.

July 1, 1896, balance unexpended	$67,287.73
June 30, 1897, amount expended during fiscal year	53,331.59
July 1, 1897, balance unexpended	13,956.14
July 1, 1897, outstanding liabilities	3,523.97
July 1, 1897, balance available	10,432.17
Amount (estimated) required for completion of existing project	753,840.67
Amount that can be profitably expended in fiscal year ending June 30, 1899	200,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1467 and of sundry civil act of June 4, 1897.	

AMOUNTS APPROPRIATED.

Act of—		Act of—	
July 25, 1868	$85,000.00	May 4, 1882	$50,000.00
April 10, 1869	178,300.00	August 2, 1882	200,000.00
July 11, 1870	250,000.00	July 5, 1884	360,000.00
March 3, 1871	250,000.00	August 5, 1886	112,500.00
June 10, 1872	225,000.00	August 11, 1888	250,000.00
March 3, 1873	225,000.00	September 19, 1890	200,000.00
June 23, 1874	225,000.00	July 13, 1892	150,000.00
March 3, 1875	250,000.00	August 17, 1894	75,000.00
August 14, 1876	250,000.00	June 3, 1896	60,000.00
June 18, 1878	350,000.00	Net receipts from other sources	3,637.88
March 3, 1879	250,000.00		
June 14, 1880	200,000.00		
March 3, 1881	200,000.00	Total	4,399,437.88
Deduct amount reverted to United States Treasury			$3,158.55
Deduct amount allotted to Harlem River			11,000.00
			14,158.55
			4,385,279.33
Amount expended to June 30, 1897			4,371,323.19

COMMERCIAL STATISTICS.

The commerce of the East River is so intimately connected with that belonging to New York Harbor proper that it is impracticable to make a separate statement of it.

BRIDGES AFFECTED BY CONGRESSIONAL OR STATE ACTS.

New York and Long Island Bridge Company's Bridge, at Blackwells Island.—Authorized by act of Congress approved March 3, 1887. The original plans for this bridge, approved by the Secretary of War in October, 1887, were amended by act of Congress

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approved March 14, 1894, which provides that the lowest part of the superstructure, over the entire width of the waterway, shall not be less than 135 feet above mean high water of spring tides. The foundations of the piers on both shores of Blackwells Island and on the Ravenswood shore have been completed, but further work has been suspended on account of legal complications.

East River Bridge Company's bridges.—By State act, March 9, 1892, the East River Bridge Company was authorized to construct a bridge between Broadway, Brooklyn, and Rivington street, New York City; and a second bridge from Bridge street, Brooklyn, to a junction in New York City with the first-mentioned bridge. The plans, providing for a height of 140 feet above mean high water at center and 120 feet at piers, for the first-mentioned bridge, and for a height of 135 feet at center and 120 feet at piers for the second bridge, were approved by the Secretary of War February 16, 1893.

New East River Bridge.—A commission for a "New East River Bridge," appointed under State act May 27, 1895, purchased the franchise of the bridge first described in the foregoing paragraph, and applied to the Secretary of War for approval of modified plans, with the Brooklyn terminal at South Fifth street, and reduction of height at center of span from 140 feet to 135 feet. The Secretary of War has authorized "a clear headway of at least 135 feet at mean high water of spring tides, under the most unfavorable conditions as to load and temperature, for a distance of not less than 200 feet on each side of the middle point of the bridge, and a height at the pierhead lines of at least 117 feet."

Plans conforming to the above requirements were submitted by the commission and approved by the Secretary of War September 24, 1896. The north caisson has been sunk on the site of the New York tower foundation, at the foot of Delancey street, and work of concreting has been begun.

E 7.

IMPROVEMENT OF NEW YORK HARBOR, NEW YORK.

New York Harbor is the general designation of the water front of and approaches to the city of New York, comprising the Upper and Lower bays, lying, respectively, inside and outside of the Narrows, between the Long Island, Staten Island, and New Jersey shores; and parts of the Hudson, East, and Harlem rivers.

At the port of New York two-thirds of the merchandise imported into the United States are received and two-thirds of the import duties collected. From this port are sent one-half of the exported domestic products of the country, and one-half of the foreign tonnage trading with the United States enters. Three-fourths of the passengers between the United States and foreign countries come and go by way of New York, and three-fifths of all immigrants land here.

New York Harbor has two entrances, one from Long Island Sound by East River and Hell Gate, used by vessels trading eastward between New York, the Eastern States, and British-American Provinces; the other, the main entrance from the sea, by Sandy Hook, through the Narrows, used by transatlantic and southern traffic.

Prior to 1884 the main or Sandy Hook entrance, with nearly 24 feet depth at mean low water, and ample breadth, sufficed for the commercial requirements of the port until the great increase in the length, tonnage, and draft of the transatlantic steamers made deepening necessary, in order to prevent the delays to which they were subjected by having to wait for high water in order to cross the bars.

Before the improvement of the Main Ship Channel was undertaken by the United States it was obstructed by four shoals, as follows:

1. The outer bar, about 4,000 feet wide, the channel across which is known as Gedney Channel, where there were depths of 23.7 feet in midchannel and 22.3 in the southern half.

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2. The shoal at the mouth of the Swash Channel, about 4,000 feet wide, where the depth was 24.3 feet.

3. The shoal northwest of Sandy Hook, about 2,000 feet wide, on which the least depth was 26.2 feet.

4. The shoal in the Main Ship Channel, west of Flynns Knoll, nearly 3 miles long, on the crest of which the depth was only 23.9 feet in mid-channel, with depths of 22.6 feet within a few hundred feet of the mid-channel range.

A large proportion of the commerce of the port, carried in deep-draft vessels, could cross these shoals only at or near high water.

The demand made in 1884 by the commercial interests centered in New York Harbor for better navigation facilities was recognized in the river and harbor act of July 5, 1884, which provided for "deepening Gedney Channel through Sandy Hook Bar, New York, $200,000."

Gedney Channel is the main channel of entrance, lying about 3 miles outside of Sandy Hook, and east by north from it. Sandy Hook is about 9 miles nearly south from the Narrows, which separates the nearest points of Long Island and Staten Island; and the Narrows, in turn, is about 7 miles south from the southern end of Manhattan Island.

From the Narrows northward to New York there is not less than 6 fathoms in the main channel.

Lower Bay is a large tidal basin, with an area of about 100 square miles, estimating westward of a line drawn from Sandy Hook to Coney Island. Its westward portion is known as Raritan Bay.

From north-northeast by east to south-southeast the Lower Bay is open to the ocean.

The shortest distance across the opening from Sandy Hook to Coney Island is 7 miles. The water cross section on this line at mean low water is about 790,000 square feet, through which the mean velocity is about 1.6 feet per second, with maximum velocities about twice as much. (Board of Engineers' Report for 1884.)

At the Narrows the channel is 1 mile wide and 70 feet deep, with depths of over 100 feet.

Below the Narrows there is one main channel, commonly known as the Main Ship Channel, leading southward to a point about 1 mile west of Sandy Hook, thence turning northward and eastward for 4 miles to the head of Gedney Channel, and thence through Gedney Channel east to deep water.

Between Sandy Hook and Coney Island there are broad shoals with five distinct channels of varying depths running through them.

The channels lie in the following order, beginning at the northward:

(1) *The Coney Island Channel.*—In which the navigable depth at mean low water is 10 feet.

(2) *The Fourteen-foot Channel.*—In which the navigable depth at mean low water is 15 feet.

(3) *The East Channel.*—In which the navigable depth of water is 19 feet.

(4) *The Swash Channel.*—Through which 22 feet can be carried at mean low water in a narrow channel.

(5) *The Main Ship Channel.*—In which, prior to 1885, 24 feet only could be carried through different reaches with lumps in them, over which the depth was only 23.3 feet at mean low water. The northern reach, along the west side of Flynns Knoll, is maintained by tidal flow through the Narrows, and the two southern reaches past Sandy Hook are maintained by the tidal prism of Raritan Bay.

These five channels are separated by shoals with from 4 to 18 feet of water over them at mean low water.

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The two latter converge into an area of about 2 miles square northeast of Sandy Hook, which has a depth in it of 30 feet of water and over, and from this area two channels lead into the open sea over the outer bar, the northernmost known as Gedney, the southernmost as the South Channel, both of which had, prior to 1885, only 24 feet at low water. Gedney Channel, the wider, was the deeper and straighter of the two, and therefore used by the larger vessels.

The Swash Channel is really a cut-off from the Main Ship Channel, leaving it about 6 miles below the Narrows, and joining it again at the western end of Gedney Channel.

As the appropriation of 1884 for the deepening of the Gedney Channel was made in advance of an approved project, the local officer was directed to make a survey of the Lower Harbor from the eastern end of Coney Island to Sandy Hook, with a view of determining the most feasible plan of improvement. The survey was completed in November, 1884, and a report recommending the improvement of Gedney Channel and the eventual improvement of the Main Ship Channel, accompanied with estimates of cost and chart, was submitted December 6, 1884. (Annual Report Chief of Engineers, 1885, p. 773.)

The navigation of the Main Ship Channel inside the bar, especially on the approach to the Narrows from the Southwest Spit, is so intimately connected with that of Gedney Channel, across the bar, that it was deemed important in submitting an estimate of cost for the improvement of the latter channel, directed to be made by Congress in the act of 1884, to extend the estimate to include the entire Main Ship Channel, and to recommend the deepening of the several intermediate shoals simultaneously. The project for deepening the channel across the bar to 28 feet by dredging received the approval of the Secretary of War December 27, 1884. (Annual Report Chief of Engineers, 1885, Part I, p. 774.)

The project provided for improving the western end of Gedney Channel for a distance of 4,000 feet, measured along its axis, and the Main Ship Channel, west of Flynn Knoll, from the Southwest Spit, north to Buoy No. 12, then situated 1½ miles south of the western entrance to Swash Channel, the depth to be 30 feet mean low water.

The cost was estimated at $970,000, not inclusive of allowance for irregularities of cutting or for increase of bulk for scow measurement. After the work had progressed for one year, and these allowances could be estimated with some degree of accuracy, the estimate was revised and the cost of executing the project as then approved was fixed at $1,370,000.

In 1887 the project was enlarged so as to cover a length of 4,500 feet in Gedney Channel measured along the axis or a length of 6,000 feet measured along the north side; to remove the shoal in the Main Ship Channel at the south entrance to the Swash Channel, afterwards called the "Bayside Channel;" to remove the shoal northwest of Sandy Hook, and to extend the Main Ship Channel north from Buoy No. 12 to and beyond the north entrance to the East Channel at Buoy No. 14 (now Buoy No. 10). The total estimated cost of the project so enlarged, based on the existing prices of dredging, was $1,490,000.

Operations for improving the lower bay, under project to provide a navigable channel 1,000 feet wide and 30 feet deep, mean low water, from the sea along Gedney Channel and the Main Ship Channel, were begun September 26, 1885, and completed October 10, 1891.

The plant which was used consisted of centrifugal pumps, installed in steamers, the excavations being dumped at sea in 14 fathoms in the vicinity of the Scotland light vessel. After the completion of the

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project the steam dredge last used by the contractors was purchased by the Government, and has since been employed to trim banks and corners and to maintain the improved channel.

The quantities of the material removed from the several reaches of the channels improved from September 26, 1885, to June 30, 1892, were as follows:

	Cubic yards.
From Gedney Channel	1,161,244
From Bayside Channel	448,313
From Northwest Shoal	118,758
From west of Flynn Knoll	3,146,764
Total quantity excavated	4,875,079

SHORE PROTECTION AT SANDY HOOK, NEW JERSEY.

The protection of the eastern and northern shores of Sandy Hook against wave and current action formed part of the project for improvement of the Main Ship Channel, but as the work required was necessarily tentative, it was deemed best to limit expenditures at the outset while studying the most economical plan.

Sandy Hook has had a varied experience in changes of form and extent resulting from tidal and current action, supplemented by wave action during storms.

The eastern shore along False Hook Channel is a long beach, remarkably uniform in its contours, and has undergone few changes, either of accumulation or loss.

From the northeast end of the Spit, westward around the Hook to beyond the Hook Beacon, the north shore is open to northerly and easterly storms and particularly subject to frequent changes, and it is on this front that the shore protections have been made.

The ravages by the sea in 1863 made shore protection a necessity, and during the following twenty years many points were protected along the crown of the Hook from east to west, by means of jetties extending at varying angles with the shore lines, from near high-water to below low-water mark.

The Main Ship Channel hugs this shore, and the water at a distance of less that 2,000 feet has a depth of over 60 feet. The slope of the foreshore is somewhat steep, and as the main object of the improvement was to preserve the high-water line and the dunes behind it, there being no marked tendency of the currents to cut below the low-water line, it was thought best to place the outer ends of the jetties near the latter curve.

Some of the jetties were built of timber, some of timber, brush, and broken stone, and others of concrete, either in bags or in forms. In 1883–84 the timber jetties were replaced by concrete, built in place and arranged in sections 10 feet long, so that when undermined, either at the ends or on the sides, settlement would be by sections, without fracturing the body of the jetty.

While these jetties served to cover a certain part of the shore line for certain winds, it was noticed that they gave no protection to the high-water line during storms from any direction which were coincident with spring tides. In the latter case, no matter what the direction of the wind, the dunes near the high-water mark were attacked by the waves.

To prevent the destruction of the dunes and arrest the recession of the high-water line before the foundations of the defenses and other

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public buildings were reached it was decided in 1890 to run a riprap wall just below high-water line completely around the Hook, uniting all the jetties.

The work was begun May, 1890, and completed September, 1891. The wall is 2,575 feet long, extending from Jetty No. 1 to about 119 feet westward of Jetty No. 11, with a cross section when first laid of 50 to 60 square feet.

The stones vary in weight from 300 pounds to 3 tons and are laid directly upon the beach, with the purpose that each stone shall arrange its bed at once after the sea attack, allowing a gradual settlement without sudden dislodgment. The cost was $6 per running foot.

During the past six years the whole wall has settled gradually, with little lateral displacement of stone, and as the result the beach is gradually building up and the high-water line moving outward.

Authority was granted by the Chief of Engineers June 6, 1894, to expend the sum of $2,000 for the protection of the beach in front of the pneumatic-gun battery, about 800 feet westward from the extreme western jetty near the Hook Beacon.

When this battery was located, in June 1889, the site was high and well inland, but the unprotected shore line in front receded so much during 1892, 1893, and 1894 that by June of the latter year the sea at high water washed the foundations of the battery and endangered the work.

A riprap wall was laid, with the allotted sum of $2,000, around the front of the battery, conformable to the method followed in building the shore protection to the eastward, which gave sufficient protection till means could be provided for extending the work eastward to connect with the old work at the beacon.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

No contracts were in force at the beginning of the year, as the channel dredging is done by the U. S. steam dredge *Gedney*, purchased in 1892.

The river and harbor act of June 3, 1896, appropriated $60,000 for continuing the improvement.

The project for the expenditure of this sum, approved by the Chief of Engineers July 6, 1896, provided for widening and deepening the improved channels near the termini of light-house ranges and removing material at any point where examination shows that shoaling has occurred in the Main Ship Channel.

The *Gedney*, which had been loaned temporarily for the improvement of Pensacola Harbor, was returned to New York August 15, 1896, and began operations August 21 on shoals caused by the wreck of the barge *Andrew Jackson* in Gedney Channel. Work by the dredge continued until December 31, 1896, trimming banks on the Main Ship Channel and removing shoal areas in Gedney and Main Ship channels. From August 21 to December 31 the dredge removed 30,882 cubic yards of material from Gedney Channel and 48,487 cubic yards from the Main Ship Channel, at a cost of 13.6 cents per cubic yard. The net cost of removing material from the date of purchase of steamer, December 1, 1892, to December 31, 1896, is 11.2 cents per cubic yard, including expenses of every kind.

December 31 the *Gedney* was withdrawn to be supplied with new boilers and for thorough repairs to hull and machinery. After adver-

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tisement, contracts were made with Hugh Ramsay, dated March 9, 1897, for repairs to hull, for $6,124, and with Harlan & Hollingsworth Company, dated March 31, 1897, for supplying in place, connected up ready for steam, two new Scotch boilers, for $12,270.

Work under the contract with Hugh Ramsay began March 11 and was completed April 30. Work under the contract with the Harlan & Hollingsworth Company began in May and will be completed September, 1897.

No work was done during the fiscal year on the sea wall and jetties built for the protection of the north shore of Sandy Hook.

No material change has taken place in the past fiscal year.

The river and harbor act of June 3, 1896, provided for a survey with estimate of cost of "New York Harbor from the Narrows to the sea, with a view of obtaining 35 feet at mean low-water mark." The report submitted January 26, 1897, states that the proposition to construct an entrance channel 35 feet deep with a width of 1,000 feet is justified by the interests of commerce, and recommends an adequate appropriation for its early completion.

The report covered estimates for channel widths as follows:

35-foot channel, 1,000 feet wide	$1,740,000
35-foot channel, 1,500 feet wide	2,772,000
35-foot channel, 2,000 feet wide	4,180,000

If done by contract, estimates to be increased 20 per cent.

The size and draft of steamers engaged in the commerce of this port are constantly increasing. While the greatest draft last year was 30 feet 6 inches, the new freight steamer *Pennsylvania* passed out on February 18, 1897, with a cargo of 18,000 tons, drawing 32 feet. Other steamers of equal and even larger dimensions are under construction and proposed.

A resurvey of the harbor from the Narrows to the sea was authorized by the Secretary of War May 13, 1897, and preparations for beginning it are in progress.

An appropriation of $500,000 is recommended, to provide for the construction of four new dredges and the running expenses for them and for the U. S. dredge *Gedney*, for continuing the widening and deepening of the entrance channels to New York Harbor.

The operations in and about New York Harbor have been supervised by Mr. G. W. Kuehnle, assistant engineer, to whom I am indebted for the most satisfactory and intelligent service rendered in the discharge of his various trusts.

This work is in the collection district of New York; nearest light-houses, Sandy Hook and Highland lights. The nearest forts are the fort at Sandy Hook and those at the Narrows.

Money statement.

July 1, 1896, balance unexpended		$111,038.34
June 30, 1897, amount expended during fiscal year		38,060.06
July 1, 1897, balance unexpended		72,978.28
July 1, 1897, outstanding liabilities	$4,249.79	
July 1, 1897, amount covered by uncompleted contracts	12,270.00	
		16,519.79
July 1, 1897, balance available		56,458.49

Amount that can be profitably expended in fiscal year ending June 30, 1899 500,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

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AMOUNTS APPROPRIATED.

For Gedney Channel, by act July 5, 1884	$200,000.00
For New York Harbor:	
Act August 5, 1886	750,000.00
Act August 11, 1888	380,000.00
Act September 19, 1890	160,000.00
Act July 13, 1892	170,000.00
Act August 17, 1894	75,000.00
Act June 3, 1896	60,000.00
Total	1,795,000.00
Received from other sources	18,424.52
	1,813,424.52
Amount expended to June 30, 1897	1,740,446.24

Abstract of proposal for repairs to hull of U. S. steam dredge Gedney, received in response to public notice dated January 30, 1897, and opened February 8, 1897, by Col. G. L. Gillespie, Corps of Engineers.

Repairs.	1. Hugh Ramsey.	
	Price per unit.	Amount.
To remove present keel for 100 feet, more or less, and replace with new 14 by 14 inch white oak, per linear foot	$5.50	$550.00
To remove garboard streaks on each side of keel for 100 feet, more or less, and replace with new, per linear foot	4.50	450.00
To remove about 13 feet of stem and replace with new white oak and put on new stem band, at	175.00	175.00
To calk entire bottom, fill seams full flush, properly point with pitch and cover with Irish felt, and then sheath with 2-inch yellow pine, planed, and fastened with 4-inch galvanized spikes; then calk sheathing with one thread cotton and one thread oakum, pay all seams with rubber seam paint, and paint bottom with two coats of copper paint, at	4,500.00	4,500.00
To take off three bottom-dump valves and fit and secure new ones, each	30.00	90.00
To shrink new wrought-iron bands on outboard hangers, lot	9.00	9.00
To remove tail shafts and put in place new shafts, shrink on couplings, and fit and secure new steel sleeves and cast-iron bushings, and also fit and secure new propeller wheels, lot	350.00	350.00
Total		6,124.00

Abstract of proposals for furnishing two marine boilers for U. S. Engineer steamer Gedney, received in response to advertisement dated February 26, 1897, and opened March 8, 1897, by Lieut. Col. William Ludlow, Corps of Engineers.

No.	Name of bidder.	Price for two boilers in place, complete.
1	James Reilly Repair and Supply Co	$13,020
2	The Neafie & Levy Ship and Engine Building Co. *a*	12,250
3	North Side Iron Works *b*	13,685
4	David M. Nichols	9,990
5	Hugh Ramsay	12,500
6	John H. Dialogue & Son	13,900
7	The Harlan & Hollingsworth Co	12,270
8	Greenlie, Wyatt & Co	16,990
9	The Charles Hillman Ship and Engine Building Co	16,250
10	Theo. Smith & Bro	15,800

a Steamer to be delivered at Philadelphia. *b* Proposals not signed.

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CONTRACTS IN FORCE.

With Hugh Ramsay, dated March 9, 1897, approved by the Chief of Engineers March 20, 1897, for repairs to hull of U. S. steamer *Gedney;* work to begin March 30, 1897; completed April 30, 1897.

With the Harlan & Hollingsworth Company, dated May 3, 1897, approved by the Chief of Engineers June 4, 1897, for furnishing two marine boilers for the U. S. Engineer steamer *Gedney*, at cost of $12,270; work to begin May 1 and to be completed September 1, 1897.

COMMERCIAL STATISTICS.

The following statement concerning the foreign commerce of New York Harbor is taken from the report of the Chamber of Commerce of the State of New York for the year 1896–97. It comprises only the foreign imports and exports of the port of New York, and does not include the domestic coastwise and local traffic. No attempt has ever been made by any commercial organization to collect the statistics for the coastwise and local traffic of New York Harbor, as the vessels and steamers bearing this commerce are not required to take out clearance papers:

Articles.	Imported.		Exported.		Total value.
	Quantity.	Value.	Quantity.	Value.	
Sugar.....pounds..	2,303,395,751	$51,151,499	.....	.....	$51,151,499
Molasses.....gallons..	657,002	79,984	.....	.....	79,984
Coffee.....pounds..	495,907,727	72,014,710	.....	.....	72,014,710
Tea.....do....	57,549,198	7,870,054	.....	.....	7,870,054
Manufactures of wool, silk, cotton, and flax.....	.....	111,462,292	.....	$11,266,049	122,928,341
Cotton.....pounds..	.....	.....	340,180,465	28,494,415	28,494,415
Hides and skins.....do....	.....	21,750,957	24,590,249	2,604,202	24,355,159
Tin.....do....	202,428,714	9,447,269	.....	.....	9,447,269
Raw silk and wool.....do....	83,846,804	15,148,574	.....	.....	15,148,574
India rubber, crude.....do....	34,265,485	15,610,870	.....	.....	15,610,870
Tobacco, and manufactures, pounds.....	20,909,152	11,733,582	160,554,918	17,568,357	29,301,939
Furs, and manufactures.....	.....	7,831,687	.....	3,314,952	11,146,639
Leather, and manufactures.....	.....	8,395,394	30,149,273	8,437,481	16,832,875
Earthen, stone, and china ware..	.....	5,434,949	.....	.....	5,434,949
Wines.....	.....	5,220,563	.....	.....	5,220,563
Coin and bullion.....	.....	30,972,139	.....	147,045,289	178,017,418
Precious stones.....	.....	6,262,584	.....	.....	6,262,584
Miscellaneous.....	.....	150,517,824	.....	107,203,869	257,721,693
Breadstuffs:					
Wheat.....bushels..	.....	.....	18,994,834	13,260,788	13,260,788
Wheat flour.....barrels..	.....	.....	4,574,125	17,202,547	17,202,547
Corn.....bushels..	.....	.....	23,527,779	10,039,598	10,039,598
All other breadstuffs.....	.....	.....	.....	6,318,095	6,318,095
Provisions.....	.....	.....	.....	66,204,917	66,204,917
Cotton-seed oil.....gallons..	.....	.....	10,096,738	2,997,290	2,997,290
Mineral oils.....do....	.....	.....	492,588,832	35,363,670	35,363,670
Cattle.....number..	.....	.....	121,877	11,954,561	11,954,561
Oil cake and meal.....	.....	.....	223,087,462	2,124,701	2,124,701
Foreign merchandise.....	.....	.....	.....	17,058,504	17,058,504
Total.....	.....	530,904,931	.....	508,459,285	1,039,364,216

Commercial statistics of the port of New York from July 1, 1896, to July 1, 1897.

Amount of revenue collected	$121,366,311.85
Value of all imports	622,019,850.00
Value of all exports	481,732,659.00

	Number.	Registered tonnage.
Foreign vessels entered	3,382	6,096,918
Foreign vessels cleared	3,288	5,827,535
American vessels from foreign ports	881	1,108,506
Coastwise vessels entered	2,552	3,256,308
Coastwise vessels cleared	2,711	3,012,454

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Statement of the number and tonnage of all vessels belonging to the port of New York, July 1, 1897.

	Number.	Registered tonnage.
Steam vessels	1,081	488,449.72
Sailing vessels	1,338	268,620.74
Barges	690	155,024.64
Canal boats	107	16,848.55

BRIDGES, TUNNELS, ETC., AFFECTED BY CONGRESSIONAL OR STATE ACTS.

1. Bridge of the North River Bridge Company across the Hudson River at Twenty-third street, New York City.—Authorized by the act of Congress July 11, 1890. The plans approved by the Secretary of War December 29, 1891, provide for an elevation of 150 feet at mean high water at center and 140 feet at piers. The act provided for commencement of construction within three years from date of passage, and authorized the Secretary of War to extend the time for two additional years. This extension was granted, but as yet no work of construction has been begun.

2. New York and New Jersey Bridge Company's Bridge, from West Fifty ninth street, New York City, to Weehawken, N. J.—Authorized by act of Congress June 7, 1894. The plans approved by the Secretary of War March 13, 1896, provide for a clear span of 3,110 feet, with a height of 150 feet above mean high water at center of span. No work of construction has yet been begun.

3. Hudson River Tunnel.—The Hudson Tunnel Railway Company was authorized by the Secretary of War July 2, 1891, to place not exceeding 20,000 cubic yards of clay upon the bed of the Hudson River on the approach to New York City. Nothing has been done under this authority, work on the tunnel being suspended.

4. Piers on Jersey Flats at Bayonne, N. J.—Under date of December 26, 1891, the Secretary of War authorized R. G. Packard to construct two piers on Jersey Flats, at Bayonne, N. J., in accordance with plans submitted. Construction work on the piers has not been begun.

E 8.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

(*1*) *Barge Andrew Jackson.*—The coal barge *Andrew Jackson*, while towing through Gedney Channel, New York entrance, May 22, 1896, was run into by the outward-bound British steamer *Vedra* and sunk in 30 feet of water in the middle of the channel, between Buoys E 7 and E 8, forming a formidable obstruction to navigation.

The barge was a three-masted wooden vessel, 182 feet long, 36 feet beam, 20 feet depth, and gross tonnage of 1,097 tons. The cargo consisted of 1,500 tons of bituminous coal.

Sealed proposals for removing the wreck and cargo were opened June 2, 1896, and that of R. G. & J. S. Packard, the lowest bidders, for $8,700, was accepted with the approval of the Acting Secretary of War June 12, 1896.

The work of removal was begun June 22 and completed August 14, at a cost of $8,880.71, by blasting and dredging.

(*2*) *Ferryboat New Brunswick.*—The ferryboat *New Brunswick*, while on fire, sunk about February 1, 1897, in 12 feet of water, just south of the Port Liberty coal wharf, Jersey City, N. J.

Sealed proposals for removing the wreck were opened February 18, 1897, and the bid of the Baxter Wrecking Company, the lowest bidder, for $895, was accepted with the approval of the Chief of Engineers March 2. The wreck was entirely removed by March 12, 1897, by floating with pontoons and transferring to a private beach at Weehawken.

(*3*) *Steamship Ailsa.*—The British steamer *Ailsa* sunk in the harbor, after collision in a fog with the steamer *La Bourgogne*, on February 29,

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1896, and has since been lying on the bottom, on the east side of the Narrows below Fort Hamilton, in about 40 feet of water.

The steamer is iron; gross tonnage, 2,061 tons; length, 290 feet 6 inches; beam, 34 feet 2 inches; depth, 23 feet 9 inches.

The owners and underwriters of the vessel and cargo made a contract with a salvage company to raise the wreck, but all attempts to do so having failed, the vessel was finally abandoned March, 1897.

Sealed proposals for breaking up and removing this wreck to a depth of 40 feet at low water, were opened May 1, 1897, and the bid of John W. Chittenden, the lowest bidder, for $11,975, was accepted with the approval of the Secretary of War May 20. Work of removal began June 1 and is still in progress.

(4) *Steamship Alvena.*—The British steamer *Alvena* sunk in New York Harbor January 19, 1897, after collision in broad daylight near the junction of the Gedney and Swash channels, with the steamer *British Queen*, and has since been lying on the bottom, 1,500 feet southeast from Bouy B 1, in the angle between the Gedney and South channels, in about 25 feet of water, and is a serious menace to navigation.

The steamer is of iron; gross tonnage, 1,741 tons; length, 274 feet 6 inches; beam, 32 feet 9 inches; depth, 24 feet 4 inches. No attempt has been made to save the vessel, which is in fact broken in two.

Sealed proposals for breaking up and wholly removing the wreck and cargo were opened June 1, 1897, and the bid of John W. Chittenden, the lowest bidder, for $36,000, was accepted with the approval of the Chief of Engineers June 24, 1897.

No work had been done on this wreck prior to the close of the fiscal year.

(5) *Canal boat Hager Johnson.*—The wreck of the canal boat *Hager Johnson* was found drifting in the North River by the supervisor's steamer *Daniel S. Lamont* on May 11, 1897, and was temporarily secured to the hulk of an old schooner a short distance below Edgewater, on the west side of the river.

Sealed proposals for the removal of this wreck were opened May 24, and the bid of the Baxter Wrecking Company, the lowest bidder, was accepted by authority of the Chief of Engineers May 28.

The wreck was floated by means of pontoons and removed by June 5 to Weehawken, at a cost of $75.

Abstract of proposals for removal of wreck of steamship Ailsa, New York Harbor, New York, received in response to advertisement dated April 1, 1897, and opened May 1, 1897, by Lieut. Col. William Ludlow, Corps of Engineers.

No.	Name of bidder.	Amount bid.	Remarks.
1	John L. Mills	$19,750	
2	Charles W. Johnston	23,500	
3	John W. Chittenden	11,975	Lowest bid.
4	R. G. Packard	33,000	

Abstract of proposals for removal of wreck of steamship Alvena, New York Harbor, New York, received in response to advertisement dated April 30, 1897, and opened at the U. S. Engineer Office, Army Building, New York City, June 1, 1897.

No.	Name of bidder.	Amount bid.	Remarks.
1	John W. Chittenden	$36,000	Lowest bid.
2	John L. Mills	37,500	

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CONTRACT IN FORCE.

With John W. Chittenden, dated May 4, 1897, approved by the Chief of Engineers June 1, 1897, for removal of wreck of steamship *Ailsa*, New York Harbor, at cost of $11,975. Work to begin May 27 and to be completed August 25, 1897.

E 9.

PRELIMINARY EXAMINATION OF CATSKILL CREEK, NEW YORK.

[Printed in House Doc. No. 56, Fifty-fourth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 3, 1896.

SIR: I have the honor to submit the accompanying copy of report, dated October 26, 1896, by Col. G. L. Gillespie, Corps of Engineers, of the results of a preliminary examination of Catskill Creek, New York, provided for by the river and harbor act of June 3, 1896.

It is Colonel Gillespie's opinion that this creek is worthy of improvement by the General Government, to the extent of providing a channel 200 feet wide and 10 feet deep at mean low water from the entrance to the railroad bridge, a distance of 1½ miles.

I concur with Colonel Gillespie to the extent of advising a survey of the creek, estimated to cost $350, upon the results of which a more reliable opinion as to the extent of the improvement justified by the commerce involved can be formed.

Very respectfully, your obedient servant,

W. P. CRAIGHILL,
Brig. Gen., Chief of Engineers.

Hon. DANIEL S. LAMONT,
Secretary of War.

REPORT OF COL. G. L. GILLESPIE, CORPS OF ENGINEERS.

ENGINEER OFFICE, UNITED STATES ARMY,
New York, N. Y., October 26, 1896.

GENERAL: Referring to Department instructions contained in circular letter dated June 16, 1896, I have the honor to submit herewith report on the preliminary examination of Catskill Creek, New York, as provided for in the river and harbor act of June 3, 1896, as follows: "Catskill Creek, New York."

This creek is a tributary of the Hudson River, into which it falls at the town of Catskill, 10 miles below the city of Hudson. It has been personally examined by the engineer in charge.

It drains a narrow valley 25 miles long, and is navigable to a point 1½ miles distant from its mouth, where it is spanned by a railroad bridge without draw. A short distance lower it is spanned by a highway bridge with a double draw opening, each 65 feet wide.

The average width of the stream in the navigable portion is 300 feet, which widens to 600 feet at the mouth. In the upper section just above and below the highway bridge, and on the bar at the entrance, the depth is 6 feet, approximately, but in all other parts it ranges from 10

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feet to 16 feet at low stage. The bar at the entrance is 1,000 feet wide, approximately, and the material is generally light and easily dredged.

The town of Catskill numbers 5,000 inhabitants, and is the origin of a large commerce, which the accompanying paper by Mr. William J. Hughes, county treasurer, estimates at not less than 250,000 tons annually. The number of passengers carried annually to and from the docks by different steamboat and ferry lines is estimated at 65,000.

This locality is not covered by an appropriation for improvement, nor has it ever been examined under direction of the War Department with a view to improvement.

The obstructions to navigation which are complained of consist of shoal depths on the bar at the entrance, and in the upper reach of the river, and a rocky point of land on the right bank below the highway bridge, which gives the channel an abrupt turn to the northward and furnishes a favorable pocket for ice jams.

The projectors of the improvement desire that a channel be provided from the entrance to the head of navigation 200 feet wide and 10 feet deep at mean low water.

The improvement may be effected at a comparatively moderate expense.

For the foregoing reasons I have the honor to report that in my judgment Catskill Creek is worthy of improvement by the General Government to the extent of providing a channel 200 feet wide and 10 feet deep at mean low water from the entrance to the railroad bridge, a distance of 1½ miles. A survey adequate for the preparation of a report and estimate of cost of the improvement justified by the commercial interests involved will cost the sum of $350.

Attention is invited to accompanying report by Mr. A. Doerflinger, assistant engineer, who has made a careful examination of the creek, and to the letter from Mr. William J. Hughes, county treasurer, relative to the business firms and corporations in the town of Catskill who do business over the town docks.

Very respectfully, your obedient servant,

G. L. GILLESPIE,
Colonel, Corps of Engineers.

Brig. Gen. W. P. CRAIGHILL,
Chief of Engineers, U. S. A.

REPORT OF MR. A. DOERFLINGER, ASSISTANT ENGINEER.

ENGINEER OFFICE, UNITED STATES ARMY,
New York, N. Y., October 1, 1896.

SIR: I have the honor to report that in accordance with your instructions I have made an examination of Catskill Creek, with a view of determining whether it is worthy of improvement by the United States Government.

Catskill Creek is a tributary of the Hudson River. It rises in the Catskill Mountains and connects with the Hudson at the village of Catskill, about 110 miles north of New York City. The creek is navigable for a distance of 1½ miles up from its mouth, where it is crossed by a permanent bridge on the line of the Catskill Mountain Railroad. Above this bridge the creek bed rises rapidly, and the character of the stream changes from that of a tidal river to that of a mountain stream.

The navigable portion of the creek has a general width of about 300 feet, except at its mouth, where it widens out to about 600 feet. The present channel depth varies from 6 to 16 feet at mean low water, the lesser depths prevailing on the bar at the mouth of the creek and in the upper sections. The village of Catskill, through which the creek flows, has about 5,000 inhabitants; there are numerous industries located on the banks of the stream, consisting mainly of brick factories, knitting

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mills, coal and lumber yards, ice houses, etc., all dependent upon the shipping facilities of the creek for the transportation of their products or material required in the manufacture thereof. The docks of the New York and Catskill line of steamers are situated on the left bank of the creek, about 1 mile up from its mouth, where direct connection is made with the trains of the Catskill Mountain Railroad, which passes through the numerous settlements of the Catskill region. There is also a line of steamers, making daily trips between Albany and Catskill, which has its docks on the creek.

The present tonnage and other statistics relating to the commerce of the creek are shown by the statement kindly furnished by Mr. William J. Hughes, county treasurer of Greene County, N. Y.

The main impediments to the free navigation of the creek, from which relief is sought, are the bar at the creek entrance, the shoals in the upper reaches, and a point of rock, partly above and partly below water, known as Hop Po Nose, which projects into the channel from the right bank at a sharp turn of the creek.

The formation of a channel about 200 feet wide and 10 feet deep, mean low water, through the bar at the mouth of the creek, together with some dredging in the upper reaches, and the possible removal of the rocky point above referred to, would, I think, meet all the necessary requirements of the navigation of the creek. As these improvements could probably be effected at a comparatively moderate outlay, and in view of the commercial importance of the stream, a survey of the creek upon which a definite project for improvement could be based would, in my judgment, be justified. The cost of such a survey would be about $350.

I am, very respectfully, your obedient servant,

A. DOERFLINGER,
Assistant Engineer.

Col. G. L. GILLESPIE,
Corps of Engineers, U. S. A.

LETTER OF MR. W. J. HUGHES.

GREENE COUNTY TREASURER'S OFFICE,
Catskill, N. Y., September 18, 1896.

DEAR SIR: Relative to the commerce of the Catskill Creek, I beg to submit the following memoranda:

The principal firms and corporations making use of the water frontage on the creek, and to the development and successful prosecution of whose business it is essential that there shall be a good depth of water and a clear channel, are:

Catskill and New York Steamboat Company, Limited.
Catskill and Hudson Steam Ferry Company, Limited.
Catskill and Albany Line.
Saugerties and Hudson Line.
Catskill Shale Brick and Paving Company, manufacturers of paving brick.
Ferrier & Goldin, brick manufacturers.
Washburn & Barnes, brick manufacturers.
Wiley Manufacturing Company, hosiery mills.
Van Brocklin & Co., hosiery mills.
New York Sand and Facing Company, manufacturers of foundry facings.
Catskill Foundry and Machine Works.
E. Lampman & Son, lumber.
John A. Foote, lumber.
Omar V. Sage, coal.
Chauncey Smith, coal.
Millington & Son, coal.
Thomas Bell, coal and ice.
H. C. Buckley, coal and ice.
Knickerbocker Ice Company, ice.
Estate of John Avery, ice.
A. Raynor, grain and feed.

The tonnage received and shipped at the docks is conservatively stated as follows:

	Tons.
Coal	66,000
Brick	125,000
Ice	30,000
Farm produce, merchants' goods, grain and feed, iron, sand, fire brick, and miscellaneous ..... 25,000 to	30,000
Total	251,000

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The number of passengers carried to and from the docks in the creek by the different steamboat and ferry lines named above is from 60,000 to 65,000.

The figures above, of course, do not include anything that is done at the docks fronting on the river at the mouth of the creek, but only what passes inside the bar. The figures are believed to be within the actual facts.

Any further information that you may consider desirable I shall be pleased to obtain, as far as practicable.

Respectfully, yours,

W. J. HUGHES.

Col. G. L. GILLESPIE,
Corps of Engineers, U. S. A.

E 10.

PRELIMINARY EXAMINATION OF NYACK HARBOR, NEW YORK.

[Printed in House Doc. No. 58, Fifty-fourth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 3, 1896.

SIR: I have the honor to submit the accompanying copy of report, dated October 26, 1896, by Col. G. L. Gillespie, Corps of Engineers, of the results of a preliminary examination of Nyack Harbor, New York, made to comply with provisions of the river and harbor act of June 3, 1896.

In Colonel Gillespie's judgment Nyack Harbor is worthy of improvement by the General Government to the extent of opening by dredging a channel, from the town docks eastward, 200 feet wide and 12 feet deep at mean low water, to connect with the channel of the river.

I concur with Colonel Gillespie to the extent of advising a survey of the harbor, estimated to cost $400, upon the results of which a more reliable opinion as to the extent of the improvement justified by the commerce involved can be formed.

Very respectfully, your obedient servant,

W. P. CRAIGHILL,
Brig. Gen., Chief of Engineers.

Hon. DANIEL S. LAMONT,
Secretary of War.

REPORT OF COL. G. L. GILLESPIE, CORPS OF ENGINEERS.

ENGINEER OFFICE, UNITED STATES ARMY,
New York, N. Y., October 26, 1896.

GENERAL: Referring to Department instructions contained in circular letter dated June 16, 1896, I have the honor to submit herewith report on the preliminary examination of Nyack Harbor, New York, as provided for in the river and harbor act of June 3, 1896, as follows: "Nyack Harbor, New York."

The harbor of Nyack has been personally examined by the engineer in charge.

The town of Nyack, 28 miles north of New York City, is situated upon the west bank of the Hudson River, which here expands into a

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large bay, 2 miles wide, known as Tappan Zee. The town and its dependencies number 10,000 inhabitants, and is the seat of many industries which rely chiefly upon the river for the transportation of the commerce originating there.

After passing Sing Sing, on the east bank, 4½ miles above Nyack, the deep-water channel traverses Tappan Zee, hugging the east bank closely until New York City is reached.

The indentation of the west shore, within which Upper Nyack, Nyack Bight, and Piermont are located, has a foreshore of very shoal water, the depths ranging from 2 feet to 10 feet at mean low water. The width of the foreshore beyond the docks at Nyack is about 1¼ miles. According to the charts of the Coast and Geodetic Survey, the bed is composed generally of soft material, which it is believed can be easily removed by ordinary dredges.

The citizens of the town and vicinity desire that a navigable channel affording 12 feet depth at mean low water be excavated, from the town docks eastward, to give access to the deep-water channel of the main river. The desired improvement may be effected at no great cost.

This locality is not covered by an appropriation for improvement, nor has it ever been examined under direction of the War Department with a view to improvement.

In view of the reasons hereinbefore stated, I have the honor to report that in my judgment Nyack Harbor is worthy of improvement by the General Government to the extent of opening by dredging a channel, from the town docks eastward, 200 feet wide and 12 feet deep at mean low water, to connect with the main channel of the river.

A survey adequate for the preparation of a report and estimate of cost of the proposed improvement justified by the commercial interests involved will cost the sum of $400.

Attention is respectfully invited to the accompanying report by Mr. A. Doerflinger, assistant engineer, made after a personal examination of the harbor, and also to letter of Mr. George B. Helmle, editor of the Nyack Journal, embodying partial statement of the commercial statistics of the harbor.

Very respectfully, your obedient servant,

G. L. GILLESPIE,
Colonel, Corps of Engineers.

Brig. Gen. W. P. CRAIGHILL,
Chief of Engineers, U. S. A.

REPORT OF MR. A. DOERFLINGER, ASSISTANT ENGINEER.

ENGINEER OFFICE, UNITED STATES ARMY,
New York, N. Y., October 1, 1896.

SIR: I have the honor to report that in accordance with your instructions I have made an examination of Nyack Harbor, New York, with the view of obtaining the necessary data to determine its worthiness of improvement by the United States Government.

Nyack Harbor is formed by an indentation in the west shore of the Hudson River between Hook Mountain on the north and Piermont Pier on the south. The Hudson River at this point expands out into a broad bay, known as Tappan Zee, the deep-water channel being close to the east shore of the river.

For a distance of about 1¼ miles out from the docks at Nyack the present depth of water is not over 6 to 7 feet at mean low tide, with a somewhat greater depth along

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the dock front. The villages of Nyack proper and South Nyack, which comprise one community of about 10,000 inhabitants, are situated on the shores of the harbor, and many of the industries located here are dependent upon the transportation facilities of the harbor for the movement of their heavy and bulky freights. A ferry makes regular trips to Tarrytown on the opposite side of the river, and a steamboat runs daily during the summer season to and from New York City. There are three shipyards, a glue and paper factory, and other industrial establishments located on the water front, while many other manufacturing establishments, comprising shoe factories, carriage and sleigh factories, cement works, etc., are located in the immediate vicinity.

The present tonnage shipped and received and other statistics relating to the commerce of the harbor are shown by the statement kindly furnished by Mr. George B. Helmle, editor of the Nyack Journal.

Owing to the shallow area lying between the natural channel of the Hudson River and the shore front at Nyack, above referred to, the docks at the latter point can only be reached by vessels of comparatively light draft, and it is from this difficulty that relief is sought. A channel from 150 to 200 feet wide and 12 feet deep mean low water, extending from the deep water of the Hudson River to the dock front of Nyack and along this front to about 500 feet north of the present ferry slip at the foot of Main street, would, I think, afford all the facilities required by the shipping interests of the place. Such a channel could probably be formed and maintained, at a moderate outlay, by dredging alone.

As the interests affected are large and the desired improvement seems feasible and necessary, a survey upon which a definite project for improvement could be based would, in my judgment, be justified. The cost of such a survey would be about $400.

The statement furnished by Mr. George B. Helmle covers only a part of the commerce of the harbor, as it does not include the tonnage received or shipped by water. An amended statement, which has been asked for, will be forwarded as soon as received.

I am, very respectfully, your obedient servant,

A. DOERFLINGER,
Assistant Engineer.

Col. G. L. GILLESPIE,
Corps of Engineers, U. S. A.

LETTER OF MR. GEORGE B. HELMLE, EDITOR NYACK JOURNAL.

NYACK, N. Y., *October 24, 1896.*

DEAR SIR: Your letter to Mr. Morrell asking for information regarding commercial statistics of Nyack has been handed me, with a request that I reply.

I cheerfully respond, but regret to say that after careful inquiry and labor I am not able, by reason of the failure on the part of individuals to give me such information as is necessary, to make an exact or even approximate estimate of the amount of business done in our harbor. No record of the amount of tonnage seems to have been kept.

The amount of freighting on the Northern Railroad, the only road leading directly into Nyack, during the year of 1895 was: Tonnage shipped, 1,752,306 pounds; tonnage received, 40,684,734 pounds.

The great bulk of our freightage is done by boat, as it is cheaper and comes without the extra handling at Jersey City. I have applied to the steamboat company for figures, but as yet have received no reply.

We have four shoe-manufacturing industries here, and they do from $300,000 to $75,000 worth of business per year, respectively. Much of their raw material comes in as freight, while the finished product is sent per Wells Fargo Express Company.

Our appeal for better harbor facilities was made primarily in behalf of the ship, boat, and yacht industries located here. The shallow water or flats in the harbor make it impossible for those engaged in the enterprise to take contracts for vessels of large size. Many a desirable contract has been lost for this reason.

I can only add that practically all of our commercial business is done by boat, and we use the railroad only when the river is closed in winter.

Yours, very truly,

GEO. B. HELMLE,
Editor Nyack Journal.

A. DOERFLINGER, Esq.,
Assistant Engineer.

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E 11.

PRELIMINARY EXAMINATION OF WALLABOUT CHANNEL, NEW YORK.

[Printed in House Doc. No. 122, Fifty-fourth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 3, 1896.

SIR: I have the honor to submit the accompanying copy of report, dated September 23, 1896, by Col. G. L. Gillespie, Corps of Engineers, of the results of preliminary examination of Wallabout Channel, New York, with a view to improvement "by cutting off portion of island known as Cob Dock and securing width of 300 feet and depth of 20 feet," as required by river and harbor act of June 3, 1896.

It is the opinion of Colonel Gillespie that Wallabout Channel is worthy of improvement by the General Government to the extent of increasing the depth of the eastern channel to 20 feet at mean low water from the entrance to the timber causeway uniting the center of the island with the United States navy yard, Brooklyn, N. Y.

I concur in the views of the district officer in so far as to advise the making of a survey, estimated to cost $250, upon the results of which a more reliable opinion can be formed as to the scope of the improvement justified by the interests involved.

Very respectfully, your obedient servant,

W. P. CRAIGHILL,
Brig. Gen., Chief of Engineers.

Hon. DANIEL S. LAMONT,
Secretary of War.

REPORT OF COL. G. L. GILLESPIE, CORPS OF ENGINEERS.

ENGINEER OFFICE, UNITED STATES ARMY,
New York, N. Y., September 23, 1896.

GENERAL: Referring to Department instructions dated June 16, 1896, I have the honor to submit, herewith, report on the preliminary examination of Wallabout Channel, New York, as provided for in the river and harbor act of June 3, 1896, as follows:

Wallabout Channel, New York, by cutting off portion of island known as Cob Dock, and securing width of three hundred feet and depth of twenty feet.

The island known as Cob Dock lies in Wallabout Bay, on the south side of East River, opposite Corlears Hook, New York City, and is wholly the property of the United States. It is retained along the East River front and well into the east channel by a well-built and durable stone wall with timber fenders, and thence along the east channel front on the south side of island by a substantial timber revetment. The eastern end of the island is covered by substantial brick buildings used as ordinance storehouses.

The locality is not covered by an appropriation for improvement, nor has it ever been examined under the direction of the War Department with the view to improvement.

The channel on the west side of the island leads to the United States navy-yard, Brooklyn, N. Y., and that on the east side to existing wharves from Broadway to Cross street, Brooklyn, and to a proposed ferry slip now building immediately to the northward of the eastern

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border of the navy-yard grounds. These two channels are separated inland by a timber causeway, without draw opening, built near the center of the island, and used to connect the navy yard with the public buildings and basins situated upon the island applied to naval purposes.

No harbor lines have ever been established by the United States along either of these channels.

When the proposed ferry has been established, it is asserted that the navigation of the east channel by ferryboats will be facilitated if the eastern end of the island be cut off so as to admit of a width of 300 feet to the channel, and that the navigation of the waterway by larger boats and vessels will be benefited if the depth be increased to 20 feet at mean low water.

The chart of this locality by the United States Coast and Geodetic Survey, No. 369[4], published in 1887, shows that the eastern entrance at the narrowest point is already 300 feet between existing pierhead at South Eleventh street, Brooklyn, and the stone wall at eastern point of the island, and that the least depth on the bar at that point is 15 feet at mean low water.

The cutting off of a short portion of the east point of the island will require the demolition of at least two valuable brick buildings and the demolition and reconstruction of about 500 feet of stone and timber retaining and revetment walls, and after these changes have been effected at considerable cost the entrance to the channel, in my opinion, based on a personal examination of the locality, will not be very greatly improved.

The waterway, however, is an important one, not only for increasing ferry accommodation between New York City and Brooklyn, but also for handling commerce at the wharves extending from West Ninth street, Brooklyn, to and beyond Wallabout Canal.

I am therefore of the opinion that Wallabout Channel is worthy of improvement by the General Government to the extent of increasing the depth of the eastern channel to 20 feet at mean low water from the entrance to the timber causeway uniting the center of the island with the navy-yard, and that the sum of $250 will be required to make such survey as will be necessary for the preparation of a report and estimate of cost of the improvement justified by the commercial interests involved.

Very respectfully, your obedient servant,

G. L. GILLESPIE,
Colonel, Corps of Engineers.

Brig. Gen. W. P. CRAIGHILL,
Chief of Engineers, U. S. A.

E 12.

PRELIMINARY EXAMINATION OF CONEY ISLAND CHANNEL, NEW YORK, FROM NORTON POINT TO THE BELL BUOY.

[Printed in House Doc. No. 59, Fifty-fourth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 3, 1896.

SIR: I have the honor to submit the accompanying copy of report, dated September 23, 1896, by Col. G. L. Gillespie, Corps of Engineers, giving results of preliminary examination of Coney Island Channel,

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New York, from Norton Point to the bell buoy to the depth of 16 feet, provided for by the river and harbor act of June 3, 1896.

It is the opinion of Colonel Gillespie that Coney Island Channel is worthy of improvement by the General Government to the extent of increasing the depth to 16 feet at mean low water.

I concur in the views of Colonel Gillespie in so far as to advise the making of a survey of the channel, estimated to cost $250, upon the results of which a more reliable opinion can be formed as to the extent of the improvement justified by the commerce involved.

Very respectfully, your obedient servant,

W. P. CRAIGHILL,
Brig. Gen., Chief of Engineers.

Hon. DANIEL S. LAMONT,
Secretary of War.

REPORT OF COL. G. L. GILLESPIE, CORPS OF ENGINEERS.

ENGINEER OFFICE, UNITED STATES ARMY,
New York, N. Y., September 23, 1896.

GENERAL: Referring to Department instructions, dated June 16, 1896, I have the honor to submit herewith report on the preliminary examination of Coney Island Channel, Lower Bay, New York Harbor, as provided for in the river and harbor act of June 3, 1896, as follows: "Coney Island Channel, New York, from Norton Point to the bell buoy to the depth of sixteen feet."

This channel is much used by small sailing vessels and steamers bound for Rockaway or other inlets on south shore of Long Island; by excursions steamers daily plying, during the summer season, between New York City and the iron pier at Coney Island or Rockaway Inlet, and by scows, loaded with city refuse, bound for the dumping buoy located in the deep pool west of the entrance to Rockaway Inlet. This locality is not covered by an appropriation for improvement, nor has it ever been examined under direction of War Department with the view to improvement.

For many years numerous complaints have been made that the channel had become obstructed by wrecks buried in the sand and by other causes, and searches have been made repeatedly for these alleged wrecks without other result than to show the existence of shoal lumps in mid-channel, caused probably by illicit dumps from city scows. No wreck was found anywhere.

The least depth on the bar at the western entrance to the Coney Island Channel, one-half mile south and east of Norton Point, as determined by an examination under direction of this office in August, 1893, was 11 feet at mean low water.

The desired improvement can be effected at small cost, and will benefit a large number of vessels and steamers which habitually use the channel. An obstruction to this channel which will require small craft bound to the small inlets to the eastward to go 1½ miles farther to the southward to the next succeeding channel through the Romer Shoals, will materially interfere with the navigation of the main ship channel by the large transatlantic steamers and vessels.

For these reasons, I have the honor to report that in my judgment, the Coney Island Channel is worthy of improvement by the General Government, to the extent of increasing the depth to 16 feet at mean low water, and that a survey adequate for the preparation of a report

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and estimate of cost of the improvement justified by the commercial interests involved will cost the sum of $250.

Very respectfully, your obedient servant,

G. L. GILLESPIE,
Colonel, Corps of Engineers.

Brig. Gen. W. P. CRAIGHILL,
Chief of Engineers, U. S. A.

E 13.

PRELIMINARY EXAMINATION OF CONEY ISLAND CREEK, NEW YORK.

[Printed in House Doc. No. 111, Fifty-fourth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C. December 3, 1896.

SIR: I have the honor to submit the accompanying copy of report, dated October 26, 1896, by Col. G. L. Gillespie, Corps of Engineers, of the results of a preliminary examination of Coney Island Creek, New York, made to comply with provisions of the river and harbor act of June 3, 1896.

It is the opinion of Colonel Gillespie, concurred in by me, that this creek is not worthy of improvement by the General Government.

Very respectfully, your obedient servant,

W. P. CRAIGHILL,
Brig. Gen., Chief of Engineers.

Hon. DANIEL S. LAMONT,
Secretary of War.

REPORT OF COL. G. L. GILLESPIE, CORPS OF ENGINEERS.

ENGINEER OFFICE, UNITED STATES ARMY,
New York, N. Y., October 26, 1896.

GENERAL: Referring to Department instructions contained in circular letter dated June 16, 1896, I have the honor to submit herewith report on the preliminary examination of Coney Island Creek, New York, as provided for in the river and harbor act of June 3, 1896, as follows: "Coney Island Creek, New York."

Coney Island Creek is a small and crooked tidal stream, 200 to 50 feet wide and 2¼ miles long, which connects, at high tide, Gravesend Bay, New York Harbor, with Sheepshead Bay, and separates Coney Island from the mainland of Long Island.

Gravesend Bay, on the west, is wide and shoal, and the distance from the mouth of the creek to the 4-foot curve of the harbor is 4,000 feet. The range of tides is 4.8 feet.

Sheepshead Bay, on the east, is a small shoal bay, with barely 5 feet depth in a narrow channel at low stage. It has little commercial importance, but has been improved with partial success by the General Gov-

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ernment to provide interior navigation by way of Dead Horse Inlet to Jamaica Bay. The range of tides is 4½ feet.

At high tide the creek provides navigation from the harbor to a point 1 mile inland, for small fishing or other craft whose draft does not exceed 6 feet, but at low water the bed elsewhere to the eastward is bare throughout the greater part of its length, and all navigation is consequently suspended. It is understood that the projectors of the survey desire to have the creek improved by making between the terminals a straight cut 200 feet wide with 8 feet depth of water at mean low water for purposes connected chiefly with land development, for which necessary State legislation has been gotten.

While it is practicable to enlarge existing navigable facilities, and to give better drainage to adjacent lands now being developed, by lowering the bed by dredging, the course of the creek is so sinuous that even under the new conditions the stream could not be used conveniently, except by a limited number of small vessels and boats. It would also seem impracticable to make the course a straight one without materially interfering with vested rights at the eastern end.

Moreover, Coney Island is the most accessible of all pleasure resorts by the sea in the vicinity of New York City, and during the summer season, covering five months at least, is visited by many thousand people daily, carried in wheeled vehicles on three highways or in steam and electric cars which cross Coney Island Creek on seven different bridges, of which the two most westerly alone are provided with draws.

It would be oppressive to require parties owning or controlling these transportation routes to reconstruct their bridges in the absence of an urgent commercial necessity, and likewise oppressive to the general public to be compelled to suffer a nuisance in the shape of drawbridges over a small stream having little commercial value, and which it is proposed to enlarge in order to develop lands, rather than to foster commerce, either local or general.

The locality is not "covered by an appropriation for improvement, nor by a former examination" made under the direction of the War Department.

After carefully considering the subject, I am of the opinion that Coney Island Creek is not worthy of improvement by the General Government.

Attention is invited to the accompanying report by Mr. A. Doerflinger, assistant engineer.

Very respectfully, your obedient servant,

G. L. GILLESPIE,
Colonel, Corps of Engineers.

Brig. Gen. W. P. CRAIGHILL,
Chief of Engineers, U. S. A.

REPORT OF MR. A. DOERFLINGER, ASSISTANT ENGINEER.

ENGINEER OFFICE, UNITED STATES ARMY,
New York, N. Y., October 19, 1896.

SIR: I have the honor to report that in accordance with your instructions I have made an examination of Coney Island Creek with the view of obtaining data necessary to determine whether it is worthy of improvement by the United States Government.

Coney Island Creek is a narrow strip of water, about 2¼ miles long, connecting Gravesend Bay and Sheepshead Bay, and with the latter separates Coney Island from the mainland. It is a tortuous, winding stream, bordered by meadow and

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marsh lands, decreasing in width from about 200 feet at its westerly end to 50 feet and less at the easterly end. The depth varies from 2 to 10 feet, mean low water, in the westerly half of the creek, while some portions at the easterly end run almost bare at low water. The creek is crossed by seven railroad and three highway bridges, the two most westerly of which only are provided with drawspans. There is practically no commerce on the creek at the present time, except in the westerly section, where several docks are located, at which coal, building material, and other heavy merchandise, mainly used at Coney Island, is received from light-draft vessels which reach the docks from Gravesend Bay.

Upon inquiry of the Member of Congress of the district, I was informed that the purpose of the contemplated improvement was to deepen, widen, and straighten the creek, so as to provide a continuous waterway from Gravesend Bay to Sheepshead Bay, 200 feet wide and about 8 feet deep at mean low water. It is claimed that such a waterway would be of great advantage, not only to the future development of the adjacent territory, but would open up an inner line of water communication between lower New York Bay and Sheepshead Bay, which in time might be extended to Jamaica Bay, and finally to the other bays farther eastward on the south side of Long Island which lie between the mainland and the narrow strip of sand beach that extends from Coney Island to the east end of Shinnecock Bay, a distance of over 80 miles.

The value and adaptability of the creek for the purpose above indicated seems to have been recognized by the town survey commission of Kings County, created by act of the legislature May 7, 1869, as in laying down a system of streets, bulkhead, pier, and basin lines for the town of Gravesend, such a channel as the one now proposed, with connecting lateral basins, is provided for in the plan of the commission for the development of the territory adjacent to the creek.

The report of the commission was filed in the office of the secretary of state May 18, 1874, and under the act thereby became legalized. The plan of improvement proposed by it is consequently now established by law. If, therefore, any improvement of the creek is to be undertaken by the United States it ought to be along the lines established by the commission, as any independent improvement of the creek, such as deepening the channel along its natural course, would conflict with the adopted plans for local improvements and enhance their ultimate cost. It is a question, however, whether the General Government can properly be called upon to assist in the execution of the project at this time. The local authorities have so far done nothing toward carrying the plans of the commission into effect, and no action has been taken to acquire the lands through which the improved channel would pass, and its excavation at the present time could therefore not be undertaken without interfering with vested rights.

A further matter for consideration in connection with the project is the necessary change involved in the location and construction of the bridges which now cross the creek. As already stated, only two of these bridges are provided with drawspans. If the creek is to be opened to through navigation, all the fixed bridges would necessarily have to be provided with drawspans, and the drawspans of the others would require modification, both as to location and character of construction; and it is questionable whether the authorities controlling them could be induced or compelled to make such modifications without compensation, or without supplemental legislation by the State and General Government.

* * * * * * *

I am, very respectfully, your obedient servant,

A. DOERFLINGER,
Assistant Engineer.

Col. G. L. GILLESPIE,
Corps of Engineers, U. S. A.

LEGISLATIVE PROVISIONS.

CHAPTER 670.—An act for the appointment of commissioners to lay out a plan for roads and streets in the towns of Kings County. Passed May 7, 1869.

* * * * * * *

SEC. 4. The said commissioners shall plan and lay out streets, roads, and avenues in the said towns, conforming to the avenues and streets, and plan of the city of Brooklyn, as now terminated at the city line, as nearly as may be practicable and judicious. They shall have a map made thereof, as decided upon by them, and shall file the same, when completed, in the office of the clerk of Kings County, and they shall place suitable monuments to indicate the several localities.

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CHAPTER 331.—April 24, 1872.

* * * * * * *

SEC. 3. The said commissioners are hereby authorized and empowered to determine and designate on the maps to be filed by them, the bulkhead and pier lines which are to form the termination of the streets and avenues adopted and laid out by them along the water front of the district under their jurisdiction on Gravesend and Jamaica bays; and they are also authorized and empowered to lay out and map interior basin and bulkhead lines on the swamp and lowlands of the said district; and such pier, bulkhead, and basin lines shall thereupon become part of the general plan of said district, in like manner with the lines of streets and avenues.

May 25, 1874, an act was passed requiring the commissioners to file copies of their maps with the clerk of each town and with the secretary of state.

These maps required no other approval than that of the commission.

E 14.

SURVEY OF NEW YORK HARBOR, NEW YORK, FROM THE NARROWS TO THE SEA, WITH A VIEW OF OBTAINING A DEPTH OF 35 FEET AT MEAN LOW-WATER MARK.

[Printed in House Doc. No. 243, Fifty-fourth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., January 28, 1897.

SIR: I have the honor to submit the accompanying copy of report, dated January 26, 1897, with map,* by Col. G. L. Gillespie, Corps of Engineers, of the results of a survey of New York Harbor, New York, from the Narrows to the sea, with a view of obtaining a depth of 35 feet at mean low-water mark, made to comply with provisions of river and harbor act of June 3, 1896.

Colonel Gillespie estimates that to obtain a channel 1,000 feet wide and 35 feet deep at mean low water would cost $1,740,000. This amount includes the cost of constructing four dredges at $100,000 each. A channel of similar depth and 1,500 feet wide is estimated to cost $2,772,000, which amount includes the cost of constructing five dredges at $100,000 each. The estimated cost of obtaining a channel of same depth and 2,000 feet wide is $4,180,000, which includes the cost of six dredges at $100,000 each.

The above estimates are based upon the net cost of dredging heretofore done in the harbor by the United States dredge.

Should the work be done by contract, the estimated cost should be increased 20 per cent, and would be as follows for a depth of 35 feet:

Channel 1,000 feet wide	$2,088,000
Channel 1,500 feet wide	3,326,400
Channel 2,000 feet wide	5,016,000

Colonel Gillespie considers the improvement providing for a channel 1,000 feet wide and 35 feet deep at mean low water from the Narrows to the sea to be a worthy one and justified by the interests of commerce involved.

For the reason that the channel through lower New York Bay is

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*Not reprinted. Printed in House Doc. No. 243, Fifty-fourth Congress, second session.

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everywhere exposed to the full action of the sea, it would be necessary either for the contractor or the Government to construct specially adapted hydraulic dredges, their number depending upon the urgency of the work.

Very respectfully, your obedient servant,

A. MACKENZIE,
Acting Chief of Engineers.

Hon. DANIEL S. LAMONT,
Secretary of War.

REPORT OF COL. G. L. GILLESPIE, CORPS OF ENGINEERS.

ENGINEER OFFICE, UNITED STATES ARMY,
New York, N. Y., January 26, 1897.

GENERAL: In obedience to instructions contained in your letter of September 5, 1896, I have the honor to submit a report on the survey of New York Harbor, to comply with the requirements of section 9 of the river and harbor act of June 3, 1896, which reads as follows:

That the Secretary of War is hereby directed, at his discretion, to cause surveys to be made and the cost of improvement to be estimated at the following localities, to wit:

* * * * * * *

New York Harbor, from the Narrows to the sea, with a view of obtaining 35 feet at mean low-water mark.

* * * * * * *

The first project for the improvement of the channel across the lower bay, from the Narrows to the sea, begun under the appropriation contained in the river and harbor act of July 5, 1884, was completed on October 10, 1891.

It provided for a continuous waterway between the defined limits 1,000 feet wide and 30 feet deep at mean low water.

Since completion the improvement has been well maintained, and shipping has in general been able to avail itself of the full channel dimensions except occasionally when westerly or northwesterly storms prevailing for a period of a few days have, by driving the water out of the bay, abnormally reduced the available depth 1 to 2 feet.

The main ship channel between the quarantine station and the Southwest Spit has slightly shoaled on the west side during the past year by the deposit of material washed in from Raritan Bay, causing a lengthening of the bank slopes, especially at points where the bed had been lowered 6 feet to 8 feet in the execution of the project for improvement by dredging. This degradation of the bank slopes was doubtless stimulated by the cutting action of the propellers of large steamers passing along and near the extreme west side of channel.

The number of steamers and sailing vessels of deep draft which come to this port through the southern or main entrance increases from year to year, and it is particularly noticeable that the draft and tonnage of the steamers have progressively increased during the past six years. In the Annual Report of the Chief of Engineers for the fiscal year ending June 30, 1890, pages 744–747, a list is given of the transatlantic steamships plying between New York City and foreign ports for the year 1885, and from April, 1889, to April, 1890. The average draft at these periods for outgoing steamers, which are usually the most heavily laden, was according to the list slightly in excess of 27 feet. Since 1890 all the steamship companies, without exception, I think, have added new

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and enlarged steamers to their lists, and the draft of some of these outward bound has been as great as 30½ feet, or a little in excess of the depth in the channel at low tide. A list of these new vessels is appended.

As these steamers require, for safe navigation, 2 to 3 feet of water under their keels, it is apparent that they can not leave port at low tide so long as the improved channel has but 30 feet at that stage.

The steamship companies and the great commercial bodies interested in the growth and advancement of the nation's commerce, wealth, and international standing unite in an appeal, supported by an impressive array of facts and arguments, that the main ship channel from the Narrows to the sea shall be deepened to 35 feet at mean low water. The letters embodying these views will be found as appendices. The channel from the Narrows to the city of New York is nowhere less than 45 feet deep, and in general is from 50 feet to 60 feet deep, with a least depth of 40 feet at the ends of the principal piers of the city.

The act under which this report is submitted makes no reference to the width of the proposed channel from the Narrows to the sea. The existing natural channel from the Narrows to the city of New York is generally 3,000 feet wide, and the natural and partly improved channel from the Narrows to the sea is 1,000 feet wide. In view of the great length of modern steamers and of the difficulty experienced in handling them in comparatively narrow channels where cross currents prevail, the concensus of opinion among steamship owners is that the improved channel from the Narrows to the sea should have even a greater width than 1,000 feet.

The following estimates of the quantities of material to be removed to provide channels of different capacities have been carefully determined by calculations based upon the soundings recorded upon the latest charts:

Estimates.

1. For a channel 1,000 feet wide and 35 feet deep at mean low water:	
(*a*) Dredging 12,000,000 cubic yards, scow measurement, at 10 cents per cubic yard	$1,200,000
(*b*) Construction of four additional dredges, at $100,000	400,000
(*c*) Contingencies of engineering	140,000
Total	1,740,000
2. For a channel 1,500 feet wide and 35 feet deep at mean low water:	
(*a*) Dredging 20,660,000 cubic yards, scow measurement, at 10 cents per cubic yard	2,066,000
(*b*) Construction of five additional dredges, at $100,000	500,000
(*c*) Contingencies of engineering	206,000
Total	2,772,000
3. For a channel 2,000 feet wide and 35 feet deep at mean low water:	
(*a*) Dredging 32,550,000 cubic yards, scow measurement, at 10 cents per cubic yard	3,255,000
(*b*) Construction of six additional dredges, at $100,000	600,000
(*c*) Contingencies of engineering	325,000
Total	4,180,000

The above estimates are based on the net cost of dredging by the U. S. dredging steamer *Gedney* from the date of its purchase, December 1, 1892, to September 30, 1895.

Should the work be done by contract, allowing a fair return to the contractor for capital invested, it is reasonable that the estimates

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should be increased 20 per cent. In this case the estimates are as follows, viz:

Channel 1,000 feet wide and 35 feet deep	$2,088,000
Channel 1,500 feet wide and 35 feet deep	3,326,400
Channel 2,000 feet wide and 35 feet deep	5,016,000

The improvement providing for a channel 1,000 feet wide and 35 feet deep at mean low water from the Narrows to the sea is, in my judgment, a worthy one, and is "justified by the interests of commerce involved," and it is recommended that an adequate appropriation be made for its early completion.

New York Harbor is for many reasons the chief port of the United States, and it may therefore demand with propriety that the main channel leading to the wharves at all the different shipping points in the upper bay shall be so deepened and widened from the Narrows to the sea as to permit the largest steamers afloat to pass freely in and out of the harbor at all stages of the tide and conditions of the weather, without let or hindrance. The attainment of such an end should not be arrested or even obstructed by a narrow spirit of economy, but the improvement should be recognized as national in its character, and should be speedily pushed to completion by the use of every modern appliance applicable to the purpose.

Since the channel through the lower bay is everywhere exposed to the full action of the sea, it will not be possible to make the necessary excavations by ordinary dredges. Hydraulic dredges, specially adapted to the work, will have to be built, either by a contractor or by the Government, and the number of such dredges will depend upon the urgency of the work.

If the work be done by the Government, and it be required that the quantity of material excavated annually shall not be less than 3,000,000 cubic yards (a reasonable quantity, considering the large and important national interests involved), the number of dredges needed, supplementary to existing plant, will be five, having each a capacity of 500,000 cubic yards per year, whose aggregate cost should not exceed $500,000.

With an enlarged plant of this character it will be possible to so conduct the work that the recommended channel, having a depth of 35 feet, will be given a width of 500 feet in two and one-half years and of 1,000 feet in four years.

If, however, it be desirable that the work shall be conducted with greater dispatch, it may be effected by increasing the number of additional dredges to six. In this latter case, the width of 500 feet will be obtained in two years and the full width of 1,000 feet in three and one-half years.

The material to be removed varies slightly in character from the eastern entrance to Gedney Channel westward and northward to the northern entrance to the Swash Channel.

In a late paper read before the Institution of Civil Engineers, London, England, the statement is made that the material removed in 1885–1891 for the improvement of New York Harbor was "principally sand and alluvial matter."

This statement is misleading as regards the alluvium. Sedimentary deposits were not found east of Flynns Knoll, but were confined solely to the main ship channel from Flynns Knoll northward toward the Narrows. The main shoal known as the "bar," obstructing this entrance to the port, lay in Gedney Channel, and was purely a "shingle shoal." It was composed of well-compacted gravel, coarse sand, and a limited

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quantity of shells for a depth of 2 feet or more, underneath which lay strata of coarse sand graded down to fine sand as the depth increased seaward. The crest of the bar was covered with very coarse shingle. Incorporated with the finer underlying gravel, in a small area at the western entrance, there was a calcareous element arising from the decomposition of the shells of marine animals of low order. It was small in quantity, but served as a matrix to cement the other elements, and tended to increase the difficulties of pumping. Immediately westward of Gedney Channel, in front of northern entrance to South Channel, the bed of the channel was formed of coarse sand, which became finer as Flynns Knoll was approached. In the main ship channel north of Flynns Knoll for a distance of 4 miles the material was fine sand, mixed with sedimentary matter nearly 2 feet deep, derived from the Raritan River and deposited during freshets. It formed a tough crust over nearly the whole of Raritan Bay and firmly resisted the action of the pumps until after it was broken up and the coarser material below could be reached by the suction. The sand was so fine that it settled slowly after pumping, and a large proportion was in consequence lost by overflow, causing an increased cost to the work of removal. It may be said, in general, that all the material lying within the limits of the channel leading from the Narrows to the sea can be readily and economically raised by means of hydraulic pumps.

The chart accompanying this report is a compilation of the surveys made under the direction of this office from time to time since the original survey of 1884 was authorized, and represents with sufficient accuracy for present purposes the condition of the main ship channel through the lower bay as it exists to-day.

COMMERCIAL STATISTICS.

The thirty-eighth annual report of the Corporation of the Chamber of Commerce of the State of New York for the year 1895–96, page 150, states the value of foreign imports and exports from the port of New York City for the year 1895, not including domestic, coastwise, and local traffic, to be $934,000,000.

As coastwise vessels and steamers do not take out clearance papers, it is not practicable to tabulate the statistics concerning this home commerce.

Attention is respectfully invited to the accompanying report by Mr. A. Doerflinger, assistant engineer, who has studied the subject with much care.

Very respectfully, your obedient servant,

G. L. GILLESPIE,
Colonel, Corps of Engineers.

Brig. Gen. W. P. CRAIGHILL,
Chief of Engineers, U. S. A.

REPORT OF MR. A. DOERFLINGER, ASSISTANT ENGINEER.

ENGINEER OFFICE, UNITED STATES ARMY,
New York, December 7, 1896.

SIR: I have the honor to submit the following report on an examination of New York Harbor made under your instructions, with a view of determining the feasibility and cost of providing a channel 35 feet deep at mean low water from the Narrows to the sea.

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The chart herewith submitted, compiled from the original survey of the lower bay made by this office in 1884, and special surveys of the various channels made as follows, viz, main ship channel from Southwest Spit north to the head of East Channel in 1893; southerly end of main ship channel, shoal northwest of Sandy Hook, and Bayside Channel in 1895; and Gedney and Swash channels in 1894, indicates that the channel depth of 30 feet mean low water, obtained by dredging mainly between September, 1885, and October, 1891, has been uniformly maintained, and that the improved channels have undergone little or no change since work on them has ceased.

The only point at which some slight redredging has been found necessary to maintain the 30-foot depth over the full channel width of 1,000 feet is in the southerly half of the main ship channel, where some slight inflow of material from the west bank of the channel had taken place, mainly between bouys C_1 and C_5. The material composing the flats on the side of the channel at this locality is a soft alluvium mixed with very fine sand, the natural angle of repose of which is very slight, and it is owing to this condition, assisted by a cross current during ebb tide, and by the wash of deep-draft vessels which are obliged to hug the west bank of the channel at this point in order to make the turn around Southwest Spit, that a greater percentage of material has come into the excavated channel here than at other points where the banks are more stable. It is believed, however, that in time, as the slopes of the channel banks become more flat, the further inflow of material from the causes mentioned will become less, and after the natural angle of repose has been reached will cease entirely.

Through Bayside and Gedney channels the material of the bottom is mainly coarse sand and gravel, which, in the westerly end of Gedney Channel, is more or less cemented together by a limy matrix originating from the decomposition of various shells distributed through the mass, and these channels have shown no tendency to shoaling since they were excavated. Judging from the experience had, therefore, in deepening existing channels to their present depth of 30 feet, mean low water, there appears to be no reason why an additional depth of 5 feet could not be permanently maintained along the present channel lines after lowering the channel bed to that extent by dredging.

The question of the practicability of deepening the Swash or East channels, preferably to the main ship channel, with the view of providing a shorter and more direct route to the sea for the largest class of vessels, has from time to time been raised; but while these routes present the advantage of being shorter and more direct, there are certain natural conditions which make it very questionable whether such channels could be maintained if opened. The Swash Channel south of the Romer Beacon is obstructed by numerous shoals of a very unstable character, which are constantly changing their positions. These shoals appear to be due to deposits of sand which are carried into the channel by the action of waves that break on the Romer Shoal during easterly gales. The least depth on this shoal, the crest of which is close to the west bank of the channel, is less than 3 feet at mean low water, and as the run of the sea during easterly winds is directly toward the channel the sand plowed up by the waves that break on the shoal is carried forward into the channel and subsequently carried along by the ebb current, which predominates over the flood, to form the sand deposits found in the southerly end of the channel. The general depth over these shoals is about 22 feet at mean low water, and, as the causes to which their existence is due will remain active in the future as heretofore, it is probable that no depth greatly in excess of what is now found over them could be maintained without constant redredging.

The East Channel is both wider and deeper than the Swash for a distance of 4 miles after branching off from the main channel, and is shorter and more direct than either of the other channels running through the shoal area lying between the east side of the main ship channel and the deep water of the sea. Its easterly end is, however, obstructed by a bar or shoal over 1¼ miles wide, with depths of only 18 to 19 feet over it at low water. This shoal consists mainly of fine sand, and to dredge a channel 1,000 feet wide and 35 feet deep through it would require the removal of nearly as much material as would be required to obtain the same channel dimensions through the main ship, Bayside, and Gedney channels; and owing to the character of the material forming the shoal, the great depth of cutting necessary, and consequent high banks of the excavated channel, it is doubtful whether a dredged channel could be permanently maintained through this shoal after it was formed.

It appears, therefore, that better and surer results are to be expected from deepening the existing channels, which already have a depth of 30 feet, although the course through these channels is not so direct and the distance to the sea is much greater than by way of either the Swash or East channel.

The total amount of material to be removed to deepen the present channel to 35 feet, mean low water, 1,000 feet wide, from the Narrows to the sea, allowing for side slopes of 1 on 10, 1 foot overdepth for irregularities of dredging, and 25 per cent for

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increase of volume from place to scow measurement, is 12,000,000 cubic yards, distributed as follows:

	Cubic yards.
Main ship channel	8,000,000
Shoal northwest of Sandy Hook	807,000
Bayside Channel	1,393,000
Gedney Channel	1,800,000
Total	12,000,000

For a channel 35 feet deep, mean low water, and 1,500 feet wide, 750 feet on either side of the present axis of main ship channel, and cut through shoal northwest of Sandy Hook, and 500 feet on the north side and 1,000 feet on the south side of the present axes of Bayside and Gedney channels, is 20,660,000 cubic yards, distributed as follows:

	Cubic yards.
Main ship channel	13,503,000
Shoal northwest of Sandy Hook	1,390,000
Bayside Channel	2,257,000
Gedney Channel	3,510,000
Total	20,660,000

For a channel 35 feet deep, mean low water, and 2,000 feet wide, 1,000 feet on either side of axes of the main ship and Bayside channels, and 500 feet on the north side and 1,500 feet on the south side of present axis of Gedney Channel, 32,550,000 cubic yards, distributed as follows:

	Cubic yards.
Main ship channel	21,133,700
Shoal northwest of Sandy Hook	1,936,700
Bayside Channel	3,525,600
Gedney Channel	5,954,000
Total	32,550,000

The net cost of removing material from the various channels by the United States dredging steamer *Gedney* from the date of purchase of the steamer, December 1, 1892, to September 30, 1895, is about 10 cents per cubic yard, including expenses of every kind. (See Report of the Chief of Engineers for 1896, p. 866.)

To do the above projected work expeditiously and economically, it would be necessary to build and operate at least four additional dredging steamers for the channel 1,000 feet wide, five for the channel 1,500 feet wide, and six for the channel 2,000 feet wide, at an estimated cost of about $100,000 each. With such a plant the channel 1,000 feet wide could be completed in about five years, the channel 1,500 feet wide in about seven years, and the channel 2,000 feet wide in about nine years. On the above basis of cost for operating expenses the estimated cost for executing the work would be as follows:

1. For a channel 35 feet deep, mean low water, and 1,000 feet wide:	
Dredging 12,000,000 cubic yards, scow measurement, at 10 cents	$1,200,000
Construction of four additional dredges, at $100,000	400,000
Contingencies of engineering	140,000
Total	1,740,000
2. For a channel 35 feet deep, mean low water, and 1,500 feet wide:	
Dredging 20,660,000 cubic yards, scow measurement, at 10 cents	2,066,000
Construction of five additional dredges, at $100,000	500,000
Contingencies of engineering	206,000
Total	2,772,000
3. For channel 2,000 feet wide and 35 feet deep at mean low water:	
Dredging 32,550,000 cubic yards, scow measurement, at 10 cents per cubic yard	3,255,000
Construction of six additional dredges, at $100,000	600,000
Contingencies of engineering	325,000
Total	4,180,000

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Should the work be done under contract the cost would probably be about 20 per cent greater than that given above, in which case the estimates are as follows:

For a channel 1,000 feet wide and 35 feet deep, mean low water	$2,088,000
For a channel 1,500 feet wide and 35 feet deep, mean low water	3,326,400
For a channel 2,000 feet wide and 35 feet deep, mean low water	5,016,000

The protection of the eastern and northern shores of Sandy Hook against wave and current action forms part of the project for the improvement of the main ship channel through the lower harbor, adopted in 1884, and should be considered in connection with the extension of this project to provide a depth of 35 feet, mean low water, now under consideration.

Since the date of the original survey, in 1884, the high-water line at the northerly end of the Hook has practically remained unchanged under the protection of the stone and concrete jetties, built in 1883–84, and connecting wall of riprap, completed in September, 1891. The Hook has, however, grown in a westerly direction, by the accretion of sand, to a marked degree, the total advance westward being over 1,300 feet, or at the rate of about 100 feet per annum. The advance of the spit has been directly across the deep channel which skirted the west side of the Hook at the date of the earlier survey, and which had depths of 40 feet and over in it where the sand is now above high water. The average width of this spit is about 400 feet, and it is probable that it will continue to grow to the westward, and may ultimately encroach upon the main channel to an injurious extent, or crowd that channel farther toward the north, unless measures are taken to arrest the supply of sand, moved along the beach by wave action from the eastward and southward, and to which the existence of the spit is due.

Such a result could probably be effected by gradually extending one or more of the existing jetties northward for some distance beyond the low-water line. As the jetty is extended its crest should be raised to above high-water level, so that the sand lodging against it will not be carried over and beyond it by wave action. By extending the most westerly of the existing jetties first, and following with others farther eastward and southward as the sand accumulates against them, a growth of the Hook to the northward and eastward could probably be induced, which would not interfere with any of the navigable channels. The extension of the jetties could be effected at a comparatively slight cost, as they could easily be built of rubble-stone of sufficient size, using the existing jetty as a base upon which to locate a track or trestle for the conveyance of the stone to the outer end and beyond it; and the cost of this work would probably fully be covered by the item of contingencies in the foregoing estimate.

I am, very respectfully, your obedient servant,

A. DOERFLINGER,
Assistant Engineer.

Col. G. L. GILLESPIE,
Corps of Engineers, U. S. A.

LETTER OF THE NORTH GERMAN LLOYD STEAMSHIP COMPANY.

NORTH GERMAN LLOYD STEAMSHIP COMPANY,
OELRICHS & CO., AGENTS,
New York, September 25, 1896.

DEAR SIR: We beg leave to acknowledge receipt of your valued favor of the 24th instant, requesting us to inform you why the proposed increase in the depth of the main ship channel from the Narrows to the sea to 35 feet at mean low water is justified in the interest of commerce.

In reply we beg leave to state that the increase in the size of ocean steamers is such as to render an increase in the depth as stated, in our opinion, necessary, in order that commerce and navigation out of this port shall not be interrupted, but every accommodation be afforded to traffic.

In former years steamers of 3,000 or 4,000 tons were considered large, but the size of steamers, as you are aware, has gradually increased, and with the increase the channels of this harbor have been deepened and this work carried out under your wise supervision, until the present depth of 30 feet at mean low water has been reached.

Transportation has been cheapened on the water as well as on the land, and by the extraordinary reduction in freight charges in the last ten or fifteen years the steamship companies have been forced to enlarge their carriers, in the same way that the railroads have been obliged to meet cheap freight rates by the enlargement of the size of the locomotives and the lengthening of trains and the increase in the number of cars hauled. The result has been that steamships of 10,000 tons or more are very

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frequent, and the depth of water required to float these steamers of course greater. Through the fact that steamship companies can offer to shippers steamships of this large size, able to carry freight at low rates, the expense of shipping our products to Europe and other countries has unquestionably been very much lowered, and to a very large extent commerce benefited. The improvement we advocate is therefore, we believe, one that should be indorsed and demanded by the entire country.

Where we now have 30 feet at mean low water we have frequently at spring low tides, or when a strong offshore wind is blowing, an actual depth of 2 or even 3 feet less. We are sure that the tidal observations that are made by your department will confirm the fact of such a fall of the tide below mean low water, in fact in some cases to nearly 4 feet below mean low water. As a number of the steamers of our line now draw over 29 feet of water, and as we are now building six large ocean steamers of 10,000 or 12,000 tons, four of which are large freight carriers and will draw probably nearly 30 feet of water, we believe that the depth of 35 feet is necessary under present conditions, for in view of the fact that the stage of the water frequently falls 2 or 3 feet below mean low-water mark, and, further, in view of the fact that a depth of 2 feet below the keels of our steamers is needed to insure safety, we believe that a proper consideration for the growth of commerce in this port requires a deepening of the channel to the figure that we have indicated.

We further desire to draw your attention to the fact that in the interest of the comfort of passengers the hour of departure of nearly all steamship lines, thanks to the great improvement already introduced in the harbor, has been fixed at a certain hour at which steamers are now able to leave, instead of sailing on the tide at varying hours, early in the morning or late in the afternoon, according to circumstances. Unfortunately several of our steamers of deep draft have been obliged to anchor and await a high tide when they have left at a time when an offshore wind was blowing or at the season of spring low tides, and with the advent of two express steamers of exceptional size and great draft of water we believe that a greater depth of water than at present will be required to enable a certain fixed hour of departure to be adhered to.

We beg leave to draw your attention to the fact that the dock department of this city has of recent years found it necessary where formerly a depth of water of 30 feet at the pier sufficed to increase that depth to 35 feet in the slips in order to prevent accidents to vessels of modern size and depth through their grounding on obstructions in less depth of water, and that in the construction of new piers and slips this requirement of 35 feet of water is now uniformly observed by the dock department.

We are, dear sir, yours, very truly,

OELRICHS & CO.

Col. G. L. GILLESPIE,
Corps of Engineers, U. S. A.

LETTER OF THE WHITE STAR LINE.

WHITE STAR LINE,
New York, September 25, 1896.

SIR: I have to acknowledge with thanks the receipt of your favor of the 24th instant, advising me that the last river and harbor act makes provision for a survey of the lower bay, New York Harbor, with the view of preparing estimate of cost of increasing the depth in the main ship channel from the Narrows to the sea to 35 feet at mean low water.

I have merely to say in reply thereto that the proposed improvements would be of the greatest assistance to all vessels coming in and out of the port, and more especially the deep-draft ships of large tonnage which are now being constructed by various nations, and having a draft of from 29 feet to 30 feet, loaded.

It very frequently happens, especially with our large cargo steamers, that they are unable to proceed to sea for several hours owing to the shoalness of the water, and it is quite possible that a delay of this sort may mean a detention of many hours, as recently happened in the case of one of our vessels, which, while waiting for water, became fog bound and was detained nearly twenty-four hours before being able to proceed to sea.

Dredging to the depth mentioned in your letter would also enable them to enter the port or proceed to sea after dark, which at the present moment is a very perilous undertaking.

I have the honor to be, sir, yours, faithfully,

H. MAITLAND KERSEY.

Col. G. L. GILLESPIE,
Corps of Engineers, U. S. A.

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LETTER OF THE CUNARD STEAMSHIP COMPANY, LIMITED.

THE CUNARD STEAMSHIP COMPANY, LIMITED,
VERNON H. BROWN & CO., AGENTS,
New York, September, 28, 1896.

SIR: I am in receipt of your favor of the 24th instant informing me that the last river and harbor act makes provision for a survey of the lower bay, New York Harbor, with a view of preparing estimate of cost of increasing the depth in the main ship channel from the Narrows to the sea to 35 feet at mean low water, and inviting an expression of opinion on my part why the proposed improvement is justified in the interest of commerce.

In reply I beg to call attention to the following facts:

While the channel has been improved to give 30 feet depth at mean low water between the Narrows and the sea, it must be borne in mind that this is not the lowest plane which the water reaches, as with strong westerly winds occurring at low-water periods this depth may be reduced from 2 to 3 feet.

The channel is rather narrow, and there are various shoal spots just outside, but in close proximity thereto, which are a source of danger when, as not infrequently happens, the buoys from any cause get out of position.

Many of the large steamers employed in the trade between Europe and New York draw when loaded about 30 feet, and could be safely loaded deeper were there sufficient water to enable them to get to sea.

With the demand for cheap transportation and the great reduction in rates of freight which has been the result, the steamship companies have been compelled to put into the trade an entirely different type of vessel, and ships of 10 to 10,000 tons have supplanted the old ones, ranging in size from 2,500 to 5,000 tons.

The draft of water has naturally increased proportionately to the size and greater capacity of these leviathans.

It must therefore be apparent that there is not a sufficient margin of safety between the present depth of water in any part of the channel and the draft of the larger class of steamers, and that to insure the minimum risk they must time their departure so as to reach the bar at the top of high water, which necessitates starting shortly after half tide and prevents their availing of the extreme draft of water in going down the bay.

It is a great hardship and causes serious loss of time to be compelled to appoint sailings to suit the tides. It is very desirable, particularly for passenger ships, to sail at a fixed hour, which would be thoroughly practicable with a mean depth of 35 feet at low water from the Narrows to the sea.

In this connection I would state that the steamer *Lucania*, drawing 29 feet, is appointed to sail hence on the 19th of December. It will be high water at the bar at 6.36 a. m. or 7.08 p. m. The sun rises at 7.20 a. m. and sets at 4.35 p. m. In order, therefore, to enable this ship to cross the bar at high water she must leave her dock at least two hours before daylight or cross the bar about two hours after sunset. Coupled with this is to be considered the danger of short tides from heavy westerly winds at that season of the year. Similar conditions also occur on the following dates, viz:

Date.	High water at the bar.	Time of leaving wharf.
October 21	7.02 a. m	1 hour and 17 minutes before sunrise.
November 3	5.18 a. m	3 hours and 30 minutes before sunrise.
Do	5.48 p. m	1 hour before sunset.
November 17	5.13 a. m	3 hours and 30 minutes before sunrise.
Do	5.32 p. m	1 hour before sunset.
November 21	7.38 a. m	1 hour and 20 minutes before sunrise.
Do	8.10 p. m	1 hour and 30 minutes after sunset.
December 5	7.31 a. m	1 hour and 30 minutes before sunrise.
Do	8.06 p. m	1 hour and 30 minutes after sunset.
December 19	6.36 a. m	2 hours and 40 minutes before sunrise.
Do	7.08 p. m	30 minutes after sunset.

The above statement shows that between October 21 and December 19 there are six days when it will be impossible for heavy-draft ships to cross the bar at high water unless they leave their docks from thirty minutes to three hours and thirty minutes after sunset or before sunrise, thereby incurring the danger of navigating down the bay as well as having to cross the bar without daylight.

The value of the largest class of passenger steamers employed in this trade may be roughly estimated at $2,500,000 each, to say nothing of the value of cargo and passengers' baggage at risk, and the annoyance and discomfort to hundreds of passengers

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who are forced to submit to several hours' detention, all of which could be easily avoided by giving the channels a reasonable and safe depth of water, which is entirely practicable, and could be done at a very moderate cost. The vast and important commercial interests of the city of New York certainly warrant its demanding that this work should be promptly commenced and pushed to completion.

Yours, truly,

VERNON H. BROWN.

Col. G. L. GILLESPIE,
Engineer Office, U. S. Army.

LETTER OF THE HAMBURG-AMERICAN LINE.

HAMBURG-AMERICAN LINE,
New York, October 6, 1896.

DEAR SIR: We are in receipt of your valued favor of September 24 regarding proposed increase in the depth of the main ship channel to 35 feet at mean low water.

In our opinion, and in that of our captains, we consider an increase of the depth, 35 feet, a matter of great importance to the port of New York, and trust that the work will be accomplished.

As you undoubtedly know, our company are now building two large steamers for the New York trade, one of which, the *Pennsylvania*, of 20,000 tons displacement, is expected here next March. These steamers, when loaded, will certainly draw 30 feet. Besides the above two steamers, we have now in our fleet five large ones which draw from 27 to 29 feet.

With steamers of this size we believe that 35 feet is necessary, as the water often falls 2 or 3 feet below the low-water mark, and a depth of 2 feet below the steamer's keel is needed for safety and steerageway.

Another important matter we respectfully beg to call your attention to is the fixing of sailing hours of our express steamers. It frequently occurs that these steamers are obliged to anchor and await high tide in order to cross the bar when an offshore wind is blowing or at spring low tide.

By having a greater depth of water than at present fixed hours of sailing could be maintained, and be a comfort to passengers.

We beg to call your attention to the following extract from Captain Barends's report to us on his last voyage to this port:

"NEW YORK, *September 25.*

"The *Normannia*, which came up to-day at nearly high water, was several times compelled to run at greatly reduced speed in the channels in consequence of not having enough steerage way, and was obliged to steer with the help of her engines. In my opinion, I believe it necessary to deepen the channels, as they evidently have been gradually filling up."

Yours, very respectfully,

HAMBURG-AMERICAN LINE,
F. G. MESMER,
General Freight Manager.

Col. G. L. GILLESPIE,
Corps of Engineers, U. S. A.

LETTER OF THE INTERNATIONAL NAVIGATION COMPANY.

INTERNATIONAL NAVIGATION COMPANY,
New York, October 7, 1896.

SIR: I am in receipt of your letter of the 24th of September, asking us to inform your office in as much detail as we choose why the cost of increasing the depth of water in the main ship channel from the Narrows to the sea to 35 feet at mean low water is justified in the interest of commerce.

I respectfully submit that the entrance to New York Harbor should be of such a character as to enable every class of vessel frequenting this port to go in and out of the port at any time of tide. I do not think this proposition requires any justification, nor do I think that it would be practicable to state the maximum sum which it would be very well worth while to spend to attain this reasonable condition. Certainly, the expenditure of many millions of dollars should not be considered excessive when it is offset by the magnitude of the steamship interests which are affected.

At the present time there is hardly a month that passes when some one or another of the great ocean passenger and freight carriers does not report touching the ground

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at some point between the Narrows and the sea, and these reports by no means come from ships which attempt to pass up and down at dead low water. It is also quite frequently necessary for the largest vessels to wait some hours for sufficient water to enable them to cross the bar. Several of this company's steamships have recently had to anchor and wait from two to five hours for sufficient water.

At the bar, with a moderate easterly swell, there would be from 3 to 5 feet rise and fall of the ends of a loaded ship proceeding out to sea. This means that they would require 18 inches to 3 feet more water than would be sufficient to float them if the water were smooth.

The large steamers in the North Atlantic trade at the present time load to a maximum draft of from 28 to 30½ feet. Many of these vessels would stop altogether at an ordinary mean low water and would strike the ground heavily at two hours' flood. In the winter months, and during the summer months, with strong northwest winds, the tide falls 2 and even 3 feet below mean low water, and we have records taken during the last five years of one tide that was 4 feet below mean low water, and sometimes the high water rises only 1 or 2 feet above a mean low water. This means that there are conditions that are not infrequent to a modern deep-draft ship, when a 35-foot channel would give no water to spare.

Yours, respectfully,

C. A. GRISCOM, Jr., *Manager*.

Col. G. L. GILLESPIE,
Corps of Engineers, U. S. A.

LETTER OF CHAMBER OF COMMERCE OF THE STATE OF NEW YORK.

CHAMBER OF COMMERCE OF THE STATE OF NEW YORK,
New York, October 15, 1896.

SIR: Yours of the 24th September to the secretary of the Chamber of Commerce has been referred to me as chairman of the committee on harbor and shipping for reply. I am aware that you have also very properly applied to the agents of the most important shipping lines for their reasons for wishing this increase in the depth of the ship channel into New York Harbor, and I have been favored with a copy of their communications in reply. They so fully set forth these reasons that I frankly admit there are no additional ones in existence now, in my opinion, needed to show the great value the increase would have to the shipping interest and to the whole United States.

The magnificent ships which have lately been placed in this service can not possibly be maintained unless every facility for saving is availed of. Their enormous expenses, by which alone the marvelous trips they make can be effected, render every delay, if even a single hour, an item to be considered and one necessary to avoid. The margin of profit on their use when their great cost is taken into account is so small that every obstacle, seemingly slight to us, goes far to discourage the creation of that class of vessels, while the inestimable comfort and speed in making the crossing is a source of pleasure and profit to the entire citizens of the United States.

I cheerfully confirm all the statements and arguments advanced by the agents of the great lines.

The Chamber cordially approved of the request, and was instrumental in obtaining the order for a survey, under which you are now acting.

Very respectfully,

A. FOSTER HIGGINS,
Chairman Committee on Harbor and Shipping.

Col. G. L. GILLESPIE,
Engineer Office, U. S. Army.

LETTER OF THE BOARD OF COMMISSIONERS OF PILOTS.

OFFICE OF THE BOARD OF COMMISSIONERS OF PILOTS,
New York, September 29, 1896.

SIR: Your letter of the 24th instant, calling for views of this board on the question of deepening the channels of this port to 35 feet at low water, was duly received, and was before the meeting held this day.

As New York desires to remain a first-class seaport, it would seem to be unnecessary to argue the proposition that she should have channels sufficiently deep for safe navigation by the largest vessels which are likely to be constructed.

There is probably a limit to the size which seagoing vessels may attain, controlled by the consideration of safety of construction and profitable use, but it is evident that

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it has not yet been reached; and as experience has shown that the large steam vessels, when fully utilized, are the most profitable, there is strong likelihood that each new vessel built for use in the port of New York will be larger than its predecessors until the limit is reached.

Vessels drawing 28 and 29 feet are now so common in the navigation of this port that they attract no attention. Deeper drafts are not infrequent, and lately (September 12) a vessel left this port drawing 30 feet 6 inches.

The pilots differ as to the amount these deep-draft vessels will send in a heavy sea on the bar, but a fair average of their opinions would be 3 feet.

It is evident that a vessel drawing 30 feet or more could not cross the bar safely at or near low tide with a heavy sea on at the present depth.

The heavy sea is often there, and the deep-draft vessels are demanding safe admission to the port.

Loss of water on the bar caused by westerly gales must also be taken into consideration. This often amounts to 3 or 4 feet.

If, therefore, deep vessels are to enter and leave the port of New York without being obliged to wait for rise of the tide, it is evident that the proposed depth of 35 feet is not too much to provide for present requirements. We can not tell what the future has in store.

By order of the board.

Very respectfully and truly, yours,

D. A. NASH, *Secretary.*

Col. G. L. GILLESPIE, U. S. A.

List of transatlantic steamships plying between New York City and foreign ports having a maximum draft of over 26 feet, giving tonnage, dimensions, and drafts (incoming and outgoing) for the year 1896. (Supplementary to list published in Annual Report of the Chief of Engineers, 1890, pp. 742–747).

[The authority for date of construction and dimensions of steamships is Lloyds Register for 1896. All drafts taken from records at New York pilot commissioners' office.]

COMPAGNIE GÉNÉRALE TRANSATLANTIQUE.

Name of vessel.	When built.	Tonnage.		Length.	Breadth.	Depth of hold.	Draft.		
		Net.	Gross.				Outgoing.		Incoming.
							Average.	Maximum.	
		Tons.	*Tons.*	*Ft. in.*	*Ft. in.*	*Ft. in.*	*Ft. in.*	*Ft. in.*	*Ft. in.*
La Normandie	1882	3,254	6,217	459 3	49 2	37 4	26 5	27 0	25 0
La Gascogne	1885	3,766	6,800	424 4	52 2	34 4	27 6	28 0	26 3
La Champagne	1885	3,413	6,800	493 4	51 8	33 8	26 0	26 0	24 3
La Bourgogne	1885	3,786	6,800	494 4	52 2	34 4	26 7	27 0	26 0
La Bretagne	1886	3,396	6,920	495 4	51 8	33 5	25 6	25 6	25 1
La Touraine	1890	2,881	8,893	520 2	56 0	34 6	26 1	26 5	24 3
WHITE STAR LINE.									
Britannic	1874	3,152	5,004	455 0	45 2	33 7	26 0	26 7	23 2
Germanic	1874	3,150	5,008	455 0	45 2	33 7	25 11	26 3	23 0
Cufic	1888	3,055	4,639	430 7	45 2	30 0	27 10	27 10	.....
Teutonic	1889	4,245	9,500	582 0	57 6	39 0	26 4	26 9	24 0
Majestic	1889	4,340	9,500	582 0	57 6	39 0	26 5	26 10	24 2
Tauric	1891	3,665	5,728	461 0	49 1	30 9	27 1	27 4	.....
Nomadic	1891	3,678	5,749	460 8	49 1	31 0	27 3	27 8	19 11
Boric	1892	4,230	6,583	470 0	53 1	31 6	26 11	27 3	22 7
Cevic	1894	5,403	8,301	500 0	60 0	38 0	27 4	28 8	20 10
Georgic	1895	6,570	10,077	558 7	60 3	36 0	28 4	29 3	22 4
CUNARD LINE.									
Servia	1881	3,971	7,392	515 0	52 1	37 0	26 11	26 11	.....
Aurania	1883	4,030	7,269	470 0	57 2	37 2	27 6	27 10	23 6
Etruria	1884	3,391	7,790	501 6	57 2	38 2	28 2	28 7	25 4
Umbria	1884	3,401	7,798	501 6	57 2	38 2	28 0	28 5	25 2
Lucania	1893	4,975	12,952	601 0	65 2	37 8	28 10	29 2	26 8
Campania	1893	4,974	12,950	601 0	65 2	37 8	28 10	29 0	27 4

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List of transatlantic steamships plying between New York City and foreign ports having a maximum draft of over 26 feet, etc.—Continued.

Name of vessel.	When built.	Tonnage. Net.	Tonnage. Gross.	Length.	Breadth.	Depth of hold.	Draft. Outgoing. Average.	Draft. Outgoing. Maximum.	Draft. Incoming.
		Tons.	*Tons.*	*Ft. in.*	*Ft. in.*	*Ft. in.*	*Ft. in.*	*Ft. in.*	*Ft. in.*
NORDDEUTSCHER LLOYD.									
Werra	1882	2,856	5,109	433 1	45 9	35 8	25 4	25 6	23 0
Aller	1885	2,779	5,381	438 0	48 1	34 6	26 0	26 4	.....
Saale	1886	2,779	5,381	439 6	48 5	34 8	25 8	26 0	22 9
Trave	1886	2,779	5,381	438 0	48 1	34 6	25 10	26 3	22 6
Lahn	1887	2,879	5,661	448 4	49 0	34 9	26 4	26 8	23 10
Kaiser Wilhelm II	1889	3,518	6,661	449 6	51 0	35 6	27 1	27 11	23 7
Spree	1890	3,171	6,963	463 0	51 8	34 1	27 10	28 0	23 8
Havel	1890	3,144	6,875	463 0	51 9	34 2	27 7	27 10	23 8
HAMBURG-AMERICAN PACKET COMPANY.									
Augusta Victoria	1889	2,614	7,148	459 3	55 7	33 8	28 0	28 5	22 5
Scandia	1889	2,510	4,243	370 7	44 3	26 5	26 2	26 2	22 7
Columbia	1889	3,737	7,578	463 5	55 6	35 5	27 0	27 4	24 6
Furst Bismarck	1890	3,226	8,430	502 6	57 6	38 0	27 5	28 3	24 5
Normannia	1890	3,750	8,250	502 0	57 6	34 0	28 6	29 0	24 10
Phœnicia	1894	4,337	6,761	460 0	52 0	31 6	28 0	29 3	23 2
Persia	1894	3,687	5,796	445 5	50 2	29 8	27 5	28 3	23 4
Prussia	1894	3,876	5,795	445 4	50 2	29 9	27 5	28 6	.....
Palatia	1894	4,271	6,687	460 0	52 0	31 6	29 0	30 6	23 3
Patria	1894	4,249	6,664	460 0	52 0	31 6	28 8	29 3	24 2
AMERICAN LINE—RED STAR LINE.									
Westernland	1883	3,691	5,736	440 0	47 2	35 3	27 0	27 3	22 6
Noordland	1883	3,346	5,212	400 0	47 0	33 4	27 0	27 7	22 8
New York	1888	5,930	10,499	527 6	63 2	39 2	27 0	27 10	23 8
Paris	1889	5,581	10,499	527 6	63 2	22 0	27 0	27 7	23 10
Friesland	1889	4,560	7,116	437 0	51 2	35 0	27 1	28 5	22 7
Southwark	1893	5,642	8,607	480 0	57 2	37 1	28 10	29 10	21 7
Kensington	1894	5,645	8,669	480 0	57 2	37 0	28 9	30 0	21 2
St. Louis	1895	5,894	11,629	535 5	63 0	26 8	27 6	28 2	25 6
St. Paul	1895	5,874	11,629	535 5	63 0	26 8	27 5	28 0	25 5
WILSON LINE.									
Martello	1884	2,439	3,709	370 0	43 1	28 4	27 4	28 0	20 1
Buffalo	1885	2,895	4,427	385 0	45 3	27 8	26 11	27 2	21 5
Colorado	1887	2,787	4,220	370 0	44 7	28 4	26 8	27 3	20 6
Francisco	1891	2,971	4,604	370 2	46 6	27 6	27 0	27 8	20 6
Idaho	1896	3,614	5,532	450 0	49 1	30 9	27 5	28 0	20 8
ANCHOR LINE.									
Furnessia	1880	3,613	5,495	445 1	44 8	34 5	26 9	27 6	25 5
City of Rome	1881	3,453	8,144	560 2	52 3	37 0	27 10	28 3	25 0
ATLANTIC TRANSPORT LINE.									
Mississippi	1890	2,388	3,732	370 8	44 2	26 6	26 0	26 0	.....
Massachusetts	1892	3,654	5,673	445 5	49 2	30 0	26 11	27 6	24 3
Manitoba	1892	3,653	5,672	445 5	49 2	30 0	26 10	27 0	21 6
Mohawk	1892	3,646	5,658	445 0	49 2	30 0	27 0	27 8	20 4
Mobile	1893	3,725	5,780	445 0	49 2	30 0	26 9	27 0	.....

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List of transatlantic steamships plying between New York City and foreign ports having a maximum draft of over 26 feet, etc.—Continued.

NATIONAL LINE.

Name of vessel.	When built.	Tonnage. Net.	Tonnage. Gross.	Length.	Breadth.	Depth of hold.	Draft. Outgoing. Average.	Draft. Outgoing. Maximum.	Draft. Incoming.
		Tons.	*Tons.*	*Ft. in.*	*Ft. in.*	*Ft. in.*	*Ft. in.*	*Ft. in.*	*Ft. in.*
Spain	1871	2,794	4,512	425 4	43 2	36 2	27 0	27 0	23 3
Europe	1891	3,400	5,302	435 0	46 4	25 2	27 3	27 9	.....
America	1891	3,340	5,158	435 0	46 3	25 2	27 6	28 1	21 4

TANK STEAMERS.

Diamant	1892	2,205	3,445	330 0	43 0	29 9	27 2	27 5	18 0
Mannheim	1892	2,207	3,447	330 0	43 0	29 9	26 9	27 0	18 0
Deutschland	1893	2,353	3,710	338 0	43 8	31 7	27 3	27 8	18 0
Lackawanna	1894	2,468	3,855	345 0	44 3	23 0	26 8	27 6	.....
Potomac	1893	2,472	3,868	345 2	44 2	23 0	26 11	27 0	.....
Excelsior	1894	2,540	3,796	338 0	43 7	31 9	26 11	27 1	18 0
Washington	1894	2,659	4,171	353 0	45 0	31 5	27 2	27 8	18 0
Rotterdam	1895	2,784	4,273	360 0	46 7	27 7	26 10	27 0	.....

NOTE.—In 1885 there were 8 steamers drawing 27 feet and over, and the greatest draft was 27 feet 3 inches. In 1890 there were 21 steamers with a maximum draft between 27 and 28 feet and 3 steamers with a maximum draft of 28 feet and over, while the greatest draft was 28 feet 4 inches. In 1896 there were 33 steamers with a maximum draft between 27 and 28 feet, 16 steamers with a maximum draft between 28 and 29 feet, and 9 steamers with a maximum draft of 29 feet and over, while the greatest draft was 30 feet 6 inches.

E 15.

MODIFICATION OF HARBOR LINES ON HUDSON RIVER FROM WEST TWENTY-THIRD STREET TO WEST EIGHTY-FIRST STREET, NEW YORK CITY.

CITY OF NEW YORK, DEPARTMENT OF DOCKS,
New York, January 25, 1897.

SIR: At a meeting of the board of docks, held the 21st instant, the following resolution was adopted:

Resolved, That the Secretary of War be, and hereby is, respectfully requested to approve and consent to a change or modification of the pierhead line on the North River, in the city of New York, as indicated on the accompanying map, and described as follows: Beginning at a point in the pierhead line on the easterly side of the North or Hudson River, established by the Secretary of War April 25, 1890, at its intersection with the westerly prolongation of the northerly line of West Twenty-third street, distant 767 feet westerly from the easterly side of Thirteenth avenue, running thence northerly in a straight line to a point in the westerly prolongation of the southerly side of West Thirtieth street, distant 1,750 feet from the westerly side of Eleventh avenue, thence in a straight line parallel with and distant 1,750 feet from the westerly side of Eleventh avenue to the westerly prolongation of the northerly side of West Eighty-first street

Yours, respectfully,

CHARLES J. FARLEY,
Assistant Secretary.

Hon. DANIEL S. LAMONT,
Secretary of War.

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[Second indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
January 26, 1897.

Respectfully referred to Col. H. M. Robert, Corps of Engineers, for consideration and report by the Board on Harbor Lines for New York Harbor and its adjacent waters.

To be returned.

A. MACKENZIE,
Acting Chief of Engineers.

[Third indorsement.]

NEW YORK HARBOR LINE BOARD,
ARMY BUILDING,
New York, February 26, 1897.

Respectfully returned to the Chief of Engineers, inviting attention to the report of the New York Harbor Line Board of this date.

HENRY M. ROBERT,
Colonel, Corps of Engineers, President of the Board.

REPORT OF BOARD OF ENGINEERS.

HARBOR LINE BOARD,
New York City, February 26, 1897.

GENERAL: The Board on Harbor Lines for New York and its adjacent waters, to whom was referred the application of the New York board of docks, dated January 25, 1897, for a modification of the pierhead line on the North River, in the city of New York, from West Twenty-third to West Eighty-first streets, have the honor to submit the following report:

The Board gave a public hearing on the 19th of February and also an adjourned one on the 26th instant, of which typewritten copies of the stenographic reports are herewith. The main objectors to the proposed modification are the riparian commissioners of New Jersey, the city of Hoboken, and the Hoboken Land and Improvement Company. Mr. Record practically represented these three interests, and his remarks are embodied in the stenographic reports. These objections were not to the modification in itself, but to the principle of refusing all extensions of the New Jersey pierhead line and allowing them on the New York side. In fact, the New Jersey representation said they had no objection to the proposed modification of the New York Harbor line, provided the line on the New Jersey side was similarly changed.

The object of the change proposed by the New York dock board is to give room for docks of 700 feet instead of 500 feet lengths, and the modification is practically to advance the pierhead line between Thirtieth and Sixty-first streets 200 feet into the river, extending this advanced line, which is straight, to Eighty-first street on the north and connecting its southern end at Thirtieth street by a straight line with the present pierhead line at Twenty-third street. This leaves the northern end of the modified line 250 feet in advance of the present pierhead line. This being objectionable, the president and chief engineer of the New York dock board stated they had no objection to the line being altered

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above Sixty-first street so that it would unite with the present pierhead line at Eighty-first.

The docks are constructed on open piling, which interferes very little with the current. The main objection to their advance is the interference with the free space between the pierhead lines for passage of vessels and for their maneuvering. The principal reason in favor of the advance is that vessels are being built of such great lengths that docks of 700 feet length will soon be, if they are not already, required for their proper accommodation.

If the request of the dock board is granted there will still be 3,000 feet clear space between the pierhead lines on the two sides of the river. With that amount of space the Board is of opinion that the interests of commerce require the advance of the pierhead lines, as requested by the New York dock board after being modified as at the hearing.

The Harbor Line Board therefore recommends that the pierhead line on the North River, in the city of New York, between Twenty-third and Eighty-first streets, be modified as indicated on the accompanying map, and described as follows:

Beginning at a point in the pierhead line on the easterly side of the North or Hudson River established by the Secretary of War April 25, 1890, at its intersection with the westerly prolongation of the northerly line of West Twenty-third street, distant 767 feet westerly from the easterly side of Thirteenth avenue; running thence northerly in a straight line to a point in the westerly prolongation of the southerly side of West Thirtieth street, distant 1,750 feet from the westerly side of Eleventh avenue; thence in a straight line parallel with and distant 1,750 feet from the westerly side of Eleventh avenue to the westerly prolongation of the northerly side of West Sixty-first street, and thence in a straight line to the intersection of the westerly prolongation of the northerly side of West Eighty-first street and the pierhead line established by the Secretary of War April 25, 1890.

Respectfully submitted.

HENRY M. ROBERT,
Colonel, Corps of Engineers.
G. L. GILLESPIE,
Colonel, Corps of Engineers.
C. W. RAYMOND,
Major, Corps of Engineers.
H. M. ADAMS,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
March 2, 1897.

Respectfully submitted to the Secretary of War.

The board of docks, New York City, by resolution adopted January 21, requested the Secretary of War to consent to a change of the pierhead line on North River, in the city of New York, north of Twenty-third street.

The papers in the case were referred to the New York Harbor Line Board, and after full consideration of the subject, including conferences with the parties in interest, the Board submits the within report, in which it is recommended that the pierhead line on the North River, in

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the city of New York, between Twenty-third and Eighty-first streets, be modified as indicated on the accompanying map (inclosure 11).

I concur in the recommendation of the Board and recommend that the Secretary place his approval both on this report and on the map, which has been prepared for his signature.

Attention is invited in this connection to requests (now in War Department) from the Hoboken Land and Improvement Company and the New Jersey riparian commission, to be heard before action is taken on the report of the Board.

JOHN M. WILSON.
Brig. Gen., Chief of Engineers, U. S. Army.

The modification of the pierhead line is approved as recommended.

DANIEL S. LAMONT,
Secretary of War.

WAR DEPARTMENT, *March 2, 1897.*

E 16.

MODIFICATION OF HARBOR LINES ON BOTH SIDES OF HUDSON RIVER FROM BATTERY PLACE TO WEST TWENTY-THIRD STREET, NEW YORK CITY, AND FROM MORRIS CANAL BASIN TO ABREAST BULLS FERRY, NEW JERSEY.

CITY OF NEW YORK,
DEPARTMENT OF DOCKS,
New York, March 20, 1897.

SIR: At a meeting of the Board of Docks held March 18, 1897, the following resolution was adopted:

Resolved, That the Secretary of War be, and hereby is, respectfully requested to approve and consent to a change or modification of the pierhead line on the North River in the city of New York, as indicated on the accompanying map, and described as follows: Beginning at a point in the westerly prolongation of the southerly side of West Thirtieth street, distant 1,750 feet westerly from the westerly side of Eleventh avenue, and running thence southerly, on a line parallel to the easterly line of Thirteenth avenue, to a point in the westerly prolongation of the northerly line of West Twenty-third street, distant 920.75 feet westerly from the easterly line of Thirteenth avenue; thence southerly to a point on the existing pierhead line established by the Secretary of War April 25, 1890, in the center of the outer end of pier No. 45; thence still southerly to a point in the existing pierhead line established by the Secretary of War April 25, 1890, at a point in the westerly prolongation of the southerly side of pier No. 1, distant 500 feet from the bulkhead line established by the Secretary of War April 25, 1890; thence southeasterly to the southwest corner of pier A; thence still southeasterly, and in a line making an angle of 60 degrees with the southerly side or pier A, to an intersection with a line parallel to and 40 feet distant southerly from the bulkhead line around the Battery established by the Secretary of War April 25, 1890; thence along said parallel line to an intersection with the southerly prolongation of the westerly side of the Barge Office building; thence northerly along said southerly prolongation of the westerly side of the Barge Office building 40 feet to the aforesaid bulkhead line established by the Secretary of War April 25, 1890.

I am directed to request you to give this Board and other parties interested a hearing on above application at the same time that the hearing for the proposed extension of the pierhead line on the New Jersey shore is given.

Yours, respectfully,

GEO. S. TERRY, *Secretary.*

Hon. RUSSELL A. ALGER,
Secretary of War.

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[Second indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
March 23, 1897.

Respectfully referred to Col. Henry M. Robert, Corps of Engineers, for consideration and report by the Board on Harbor Lines for New York Harbor and its adjacent waters.

By command of Brig. Gen. Wilson:

A. MACKENZIE,
Lieut. Col., Corps of Engineers.

[Third indorsement.]

NEW YORK HARBOR LINE BOARD,
New York City, May 6, 1897.

Respectfully returned to the Chief of Engineers, inviting attention to the report of the New York Harbor Line Board dated May 6, 1897.

HENRY M. ROBERT,
Colonel, Corps of Engineers,
President Harbor Line Board.

LETTER OF MR. JOHN C. PAYNE, SECRETARY RIPARIAN COMMISSION OF NEW JERSEY.

RIPARIAN COMMISSION OF THE STATE OF NEW JERSEY,
FULLER BUILDING, NO. 1 MONTGOMERY STREET,
Jersey City, N. J., February 26, 1897.

DEAR SIR: The riparian commission of the State of New Jersey hereby respectfully makes application for the extension of the exterior pierhead line in the Hudson River, as follows:

Beginning at a point in the present pierhead line on the westerly shore of the north or Hudson River, established by the War Department March 4, 1890, said point being 1,423 feet easterly at right angles from the easterly line of Hudson street in Hoboken, and 275 feet southerly at right angles from the southerly line of Ninth street produced easterly in the city of Hoboken; thence running in a southerly direction in a straight line to a point 1,542.6 feet easterly at right angles from the said easterly line of Hudson street and 171.76 feet northerly at right angles from the northerly line of Fifth street extended easterly in Hoboken; thence southwesterly in a straight line parallel to the present established pierhead line and 180 feet distant easterly therefrom to a point 1,395 feet easterly at right angles from the easterly line of said Hudson street and 200 feet northerly at right angles from the southerly line of Ferry street extended, in Hoboken; thence southwesterly in a straight line to a point in the established pierhead line at its intersection with the northerly line of Thirteenth street extended in Jersey City.

The extension of the line asked for is shown upon the annexed map.

Respectfully submitted.

THE RIPARIAN COMMISSION OF NEW JERSEY.
JOHN C. PAYNE, *Secretary.*

Hon. DANIEL S. LAMONT,
Secretary of War.

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[Second indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
March 8, 1897.

Respectfully referred to Col. Henry M. Robert, Corps of Engineers, for consideration and report by the Board on Harbor Lines for New York Harbor and its adjacent waters.

If a public hearing be considered necessary and desirable, and a recommendation for such hearing be submitted by the Board, the matter will be presented to the Secretary of War for his action.

By command of Brig. Gen. Wilson.

A. MACKENZIE,
Lieut. Col., Corps of Engineers.

[Third indorsement.]

NEW YORK HARBOR LINE BOARD,
New York, May 6, 1897.

Respectfully returned to the Chief of Engineers, inviting attention to the report of the New York Harbor Line Board dated May 6, 1897.

HENRY M. ROBERT,
Colonel, Corps of Engineers,
President Harbor Line Board.

REPORT OF BOARD OF ENGINEERS.

HARBOR LINE BOARD,
New York City, May 6, 1897.

GENERAL: The Board on Harbor Lines for New York and its adjacent waters, to which was referred the application of the New York department of docks, dated March 20, 1897, for an extension of the pierhead line on the North River in the city of New York from West Thirtieth street to the Barge Office building at the Battery; and the applications of the riparian commission of New Jersey, dated February 26, 1897; the Hoboken Land and Improvement Company and others (without date); the New York and New Jersey Bridge Company, dated March 15, 1897, and Mr. Edwin King, dated April 16, 1897, for an extension of the pierhead line on the New Jersey side of the North River, has the honor to submit the following report:

The Board gave a public hearing on April 22, 1897, which was largely attended by parties in interest. No objection to the several applications was made, but on the contrary there seemed to be a general expression in favor of increased dock facilities on both sides of the river, which, in the opinion of the Board, the arguments of the interested parties fully justified. At the time of the hearing the department of docks of New York City modified somewhat their original application relative to pierhead extension north of Pier No. 1, and afterwards wholly withdrew that part of their application which referred to a proposed modification along Battery Park wall east of Pier 1.

After carefully considering the whole subject, the Board is of the opinion that the modifications requested for both sides of the river, with slight changes, are in the interests of commerce, for the reasons given in its report of February 26, 1897, on modification of the New York harbor line above Thirtieth street, and may be made without injuriously affecting navigation. The minimum width of waterway of

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2,700 feet and over between pierhead lines on opposite sides of the river has been maintained without diminution from Castle Point to Pavonia Ferry, where the least width has always existed, and the new lines now proposed for adoption tend to favor rather than obstruct the natural flow of the currents.

The Board therefore recommends that the pierhead lines of the Hudson River on the east bank from Pier No. 1 northward to Pavonia Ferry, and on the west bank from the Morris's Canal Basin northward to Castle Point, and also from near the docks of the New York, Lake Erie and Western Docks Improvement Company at Weehawken Cove northward to Bulls Ferry be modified as shown on the accompanying tracing. The pierhead lines as recommended for adoption are described as follows:

MODIFIED PIERHEAD LINE FROM BATTERY PLACE TO WEST TWENTY-THIRD STREET, NEW YORK CITY.

Beginning at a point in the westerly prolongation of the southerly side of New Pier No. 1, Battery Place, 500 feet from the established bulkhead line, being a point in the pierhead line approved by the Secretary of War April 25, 1890; thence in a straight line to a point in the westerly prolongation of the southerly side of New Pier No. 34, 1,092.5 feet west from the east side of West street; thence in a straight line to a point 950 feet west of the east side of West street, measured on a line drawn through the southeast corner of West and Gansevoort streets and perpendicular to said West street; thence in a straight line to a point in the westerly prolongation of the northerly side of West Twenty-third street distant 767 feet from the easterly side of Thirteenth avenue, which point is the southern extremity of the pierhead line approved by the Secretary of War March 2, 1897.

MODIFIED PIERHEAD LINE FROM MORRIS CANAL BASIN TO ABREAST BULLS FERRY, NEW JERSEY.

Beginning at a point in the pierhead line (on the westerly shore of the Hudson River) approved by the Secretary of War March 4, 1890, said point being in the easterly prolongation of the center line of the pier on the north side of Morris Canal Basin, 900 feet from the easterly side of Hudson street prolonged southerly; thence in a straight line to a point on a line 200 feet north of and parallel to the south side of Ferry street and 1,395 feet east from the east side of Hudson street; thence in a straight line to a point on a line 171.76 feet north of and parallel to the north side of Fifth street and 1,542.6 feet east from the east side of Hudson street; thence in a straight line to a point on a line 275 feet south of and parallel to the south side of Ninth street and 1,423 feet east of the east side of Hudson street; thence continuing along the pierhead line approved by the Secretary of War March 4, 1890, and April 25, 1890, to a point in the easterly prolongation of a line passing through the Monument B north of the New York, Lake Erie and Western Docks Improvement Company, easterly 1,432 feet from said monument as shown on map; thence in a straight line to a point in a line passing through the tavern at the Shore Road south of Guttenberg, 500 feet east of the established bulkhead line or 1,680 feet from said tavern; thence in a straight line to the point of intersection with the pierhead line established by the Secretary of War October 18, 1890, 1,290 feet easterly from Shady Side Hotel, Bulls Ferry, as shown on the map.

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The stenographer's report of the hearing of April 22, 1897, is inclosed herewith.

Respectfully submitted.

HENRY M. ROBERT,
Colonel, Corps of Engineers.
G. L. GILLESPIE,
Colonel, Corps of Engineers.
WILLIAM LUDLOW,
Lieut. Col., Corps of Engineers.
C. W. RAYMOND,
Major, Corps of Engineers.
H. M. ADAMS,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
May 12, 1897.

Respectfully returned to the Secretary of War.

In the matter of the applications of the riparian commission of New Jersey (dated February 26, 1897), the New York and New Jersey Bridge Company (dated March 15, 1897), the New York department of docks (dated March 20, 1897), Mr. Edwin King (dated April 16, 1897), and the Hoboken Land and Improvement Company and others (without date), for the extension of the pierhead line on the east and west sides of North River.

The subject has been carefully considered by the New York Harbor Line Board, which, after thorough discussion at a public hearing held for the accommodation of the parties in interest, submits the within report, to which attention is respectfully invited.

The Board states that no objection was made to the several applications, but that the general expression appeared to be favorable to the extension of the lines in the interest of increased dock facilities on both sides of the river. In the opinion of the Board the desired extension, with slight changes, can be made without injuriously affecting navigation.

Accordingly the Board recommends that the pierhead lines of the Hudson River on the *east bank*, from Pier No. 1 northward to Pavonia Ferry, and on the *west bank*, from Morris Canal Basin northward to Castle Point, and also from near the docks of the New York, Lake Erie and Western Docks Improvement Company at Weehawken Cove northward to Bulls Ferry, be modified as shown on the accompanying tracing and described in the within report.

I concur in the views of the Board and recommend that the modifications be approved, and that the Secretary place his approval both upon this report and upon the tracing which has been prepared for his signature.

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

[Second indorsement.]

WAR DEPARTMENT, *May 18, 1897.*

Approved as recommended by the Chief of Engineers.

R. A. ALGER,
Secretary of War.

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E 17.

MODIFICATION OF HARBOR LINES AT ELLIS ISLAND, NEW YORK HARBOR.

TREASURY DEPARTMENT,
OFFICE OF THE SECRETARY,
Washington, D. C., October 13, 1896.

SIR: I have the honor to inclose herewith for your information letter received from the commissioner of immigration at the port of New York, together with rough tracing of Ellis Island, New York Harbor, and, as recommended therein, have to request that the War Department approve the plan for enlarging the boundary of the northwest side of said island some 200 feet.

Respectfully, yours,

C. S. HAMLIN, *Acting Secretary.*

The Honorable the SECRETARY OF WAR.

[Second indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
October 16, 1896.

Respectfully referred to Col. G. L. Gillespie, Corps of Engineers, for report.

To be returned.

W. P. CRAIGHILL,
Brig. Gen., Chief of Engineers.

[Third indorsement.]

U. S. ENGINEER OFFICE,
New York, October 19, 1896.

Respectfully returned to the Chief of Engineers, United States Army.

The extensions on the northeast and southeast sides were approved by the Assistant Secretary of War July 20, 1896.

The island lies within the area known locally as "Jersey Flats," where the depth is only 3 to 4 feet at mean low water. No navigable channel is involved.

I see no objection to authorizing the extension of 200 feet on the northwest side, as applied for.

G. L. GILLESPIE,
Col., Corps of Engineers.

[Fourth indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
October 27, 1896.

Respectfully returned to the Secretary of War.

The Treasury Department requests modification of harbor lines at Ellis Island, New York Harbor.

Inviting attention to the foregoing indorsement of October 19 by Colonel Gillespie, and to that officer's further report of October 23 on the subject, I have the honor to recommend that the modification of harbor lines at that locality shown on the accompanying map be approved.

A. MACKENZIE,
Acting Chief of Engineers.

NOTE.—The lines referred to in the above letter, and shown on the map accompanying, were approved by the Secretary of War under date of October 30, 1896, the approval being indicated on the map.

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LETTER OF DR. J. H. SENNER, COMMISSIONER OF IMMIGRATION.

OFFICE OF U. S. COMMISSIONER OF IMMIGRATION,
Ellis Island, New York Harbor, October 9, 1896.

SIR: In connection with the general plan of enlarging the boundaries of this island, I beg to state that Special Inspector J. C. Neilson has just submitted a report to the effect that the bulkhead built some years ago on the northwest side of the island does not conform to the boundary fixed in the year 1890 by the United States commission, as will be observed by reference to the map recently sent the Commissioner-General of Immigration, and roughly indicated on the inclosed tracing of the island.

The War Department is, of course, aware of the recent necessity of adding the northeast enlargement of 100 feet and 125 feet on the southeast side, which just sufficed to come within the boundaries established by the commission above referred to, and I would now respectfully recommend that the War Department be requested to approve the plan for enlarging the boundary on the northwest side some 200 feet, which would rectify the error occasioned by the nonconforming outline of the present limit of the island on this side. With the addition of this 200 feet on the northwest side the limits of the island would be within 1,125 feet by 900 feet and the extension would form a most desirable addition for future use.

Respectfully, yours,

Dr. J. H. SENNER,
Commissioner.

Hon. J. G. CARLISLE,
Secretary of the Treasury.
(Through Commissioner-General of Immigration.)

LETTER OF THE ACTING CHIEF OF ENGINEERS.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., October 22, 1896.

COLONEL: Referring to your indorsement of October 19 respecting harbor lines at Ellis Island and to previous correspondence on this subject, I send you herewith a map of the locality showing the lines as they will appear if the proposed change is adopted, the lines in brown showing the latest modification suggested.

You are requested to state whether this brown line should be for its entire length (900 feet) a pier and bulkhead line, or whether 325 feet of it should be pierhead line, 375 feet pier and bulkhead line, and 200 feet pierhead line, to correspond with the divisions in the blue and red (shoreward) lines. It is suggested that possibly some other changes might be desirable in the designations of the other exterior lines, and on this subject your views are requested.

How would it do to call all the exterior lines pier and bulkhead lines and permit solid filling within the entire rectangle if the Treasury authorities so desire?

Very respectfully, your obedient servant,

A. MACKENZIE,
Acting Chief of Engineers.

Col. G. L. GILLESPIE,
Corps of Engineers.

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REPORT OF COL. G. L. GILLESPIE, CORPS OF ENGINEERS.

ENGINEER OFFICE, UNITED STATES ARMY,
New York, N. Y., October 23, 1896.

GENERAL: Referring to Department letter of October 22, 1896 (16164), on the subject of harbor lines at Ellis Island, New York Harbor, I have the honor to say that the Harbor Line Board in its report of June 21, 1890, recommended separate pierhead and bulkhead lines on the north and south sides of the island, for the reason that on the former side small piers already existed, and on the latter a landing basin was projected. The basin was intended to be the principal point of landing and shipment of immigrants, and therefore a larger concession was made in regard to the length of piers exterior to the basin, which might be required in the future. As no piers were projected on the east and west sides, the harbor lines were made coincident there.

The Board has always been very conservative in its recommendations for the establishment of harbor lines, and in this particular case did not think it advisable to recommend any more solid filling than the petitioners applied for.

The demands of the Government for housing accommodation of immigrants are now very large, and as the waters around the island are shoal and are not needed for purposes of navigation of the port, I see no objection to calling "all exterior lines pier and bulkhead lines," and permitting "solid filling within the entire rectangle if the Treasury authorities so desire."

Very respectfully, your obedient servant,

G. L. GILLESPIE,
Colonel, Corps of Engineers.

Brig. Gen. W. P. CRAIGHILL,
Chief of Engineers, U. S. A.

E 18.

MODIFICATION OF HARBOR LINES ON HARLEM RIVER AND SPUYTEN DUYVIL CREEK, NEW YORK CITY.

Hon. DANIEL S. LAMONT,
Secretary of War:

The undersigned petitioners respectfully represent:

That they are the owners in fee simple as tenants in common and entitled to the free and full use and occupation of certain lands hereinafter more particularly described, situated on Spuyten Duyvil Creek, in the city, county, and State of New York.

That annexed hereto, marked A, is a plan which shows the location of the said property, and other adjoining property, together with certain lines marked thereon to which reference will be hereinafter made.

That the property owned by your petitioners, including land both above and under water, is colored yellow therein.

That on or about October 18, 1890, the War Department of the United States established certain harbor lines beyond which no piers, wharfs, bulkheads, or other works shall be extended or deposits made, except under such regulations as may be prescribed from time to time by the Secretary of War.

That annexed hereto, marked B, is a map or plan, showing the said lines so established by the said War Department on Spuyten Duyvil Creek affecting the property owned by your petitioners.

That your petitioners further show that the lines so established by

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the said War Department on Spuyten Duyvil Creek excludes from use and places within the harbor lines a very large and valuable portion of the upland now owned by your petitioners, and also portions of the land under water also owned by your petitioners.

That since the building of the Harlem Ship Canal the said portion of Spuyten Duyvil Creek above referred to will not be needed for navigation, and is only useful to furnish a supply or flow of water in the said canal.

That as your petitioners are informed and believe, it is not contemplated by the Government to utilize the said creek in any way which would necessitate the taking of the said land.

That the taking of said land for either purpose, to wit, navigation or water supply, would not only be unnecessary, but would involve a large and unnecessary expense to the Government and would accomplish no substantial good.

That the stream at the point spoken of is wide enough for both purposes without taking possession of any of the land owned by your petitioners.

That the establishment of said present harbor line affects injuriously the rights of your petitioners in said land and prevents all beneficial enjoyment of their said land.

Wherefore your petitioners respectfully ask that the said harbor lines may be changed so as to relieve the land of your petitioners and if practicable to conform to the harbor commissioner's bulkhead and exterior line of water grant, shown on Exhibit A, hereto annexed.

New York, November 21, 1896.

J. C. RODGERS.
EDWARD J. FARRELL.

KELLOGG, ROSE & SMITH,
Attorneys for Petitioners,
120 Broadway, New York City.

[Second indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
November 28, 1896.

Respectfully referred to Col. Henry M. Robert, Corps of Engineers, senior member of the New York Harbor Line Board, for report.

W. P. CRAIGHILL,
Brig. Gen., Chief of Engineers.

[Third indorsement.]

NEW YORK HARBOR LINE BOARD,
New York City, December 31, 1896.

Respectfully returned to the Chief of Engineers, with report of the Board bearing date December 28, 1896.

HENRY M. ROBERT,
Colonel, Corps of Engineers, President of the Board.

REPORT OF BOARD OF ENGINEERS.

HARBOR LINE BOARD,
New York City, December 28, 1896.

GENERAL: The Harbor Line Board for New York Harbor and adjacent waters has carefully considered the petition of Messrs. J. C. Rodgers and Edward J. Farrell for a change in the existing harbor lines in the vicinity of their property on Harlem River, New York (erroneously des

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ignated in map attached to the petition as on Spuyten Duyvil Creek), which was referred to the Board for report by your indorsement of November 28, 1896, and has the honor to submit the following report thereon:

A public hearing in this matter was held by the Board in the Army Building, this city, on December 28, 1896, of which notice had previously been given to the public by advertisement in the daily papers, and also individual notices to all owners of property in the locality in question whom the Board were able to reach. A stenographic report of this hearing accompanies this report, marked A. The stone bridge at Kingsbridge is the dividing line between the Harlem River and Spuyten Duyvil Creek.

The harbor lines which the petitioners apply to have changed are located along the old bed of the Harlem River from the eastern end of Dyckmans Creek northward and westward, past Kingsbridge, and through Spuyten Duyvil Creek to the western end of Dyckmans Creek, and were established by the Secretary of War under date of October 18, 1890.

The harbor lines first drawn in this locality were established by the harbor commissioners of New York in 1857; they were exterior to the headlands and provided an open waterway 120 feet to 150 feet wide.

These lines were superseded by those established under State law by the Central Park Commissioners of New York City in 1868, which gave a waterway 200 feet wide in the vicinity of Kingsbridge, and 300 feet wide along the Harlem River and Spuyten Duyvil Creek branches.

In 1875 a project was approved by the Government for forming a navigable connection between the Hudson River and the East River by way of the Harlem River, which provided for the abandonment of the old bed of the Harlem River in the vicinity of Kingsbridge, and the excavation of a new channel along Dyckmans Creek. The plan contemplated that the improved channel along Dyckmans Creek should have a width of 350 feet and a depth of 18 feet at mean low water, but elsewhere a width of 400 feet and a depth of 15 feet. In this connection the report of the local officer says, "it is desirable that the cross section of the channel be kept as uniform as possible, in order to avoid the unnecessary resistances to the flow of the water which would be caused by any contraction of the waterway.

"The contraction of the proposed cut through Dyckmans Meadows will be more than counterbalanced by the natural channel through Spuyten Duyvil by the way of Kingsbridge, which is left open." * * * (See Annual Report of Chief of Engineers for 1887, part 1, p. 667.)

When the Harlem River was considered by the Harbor Line Board in 1890, the precaution of keeping open the old Harlem River, as suggested by the local officer, was deemed so important that the harbor lines established by the Central Park Commissioners in 1868 were recommended for adoption, and, as has been stated, were established by the Secretary of War in 1890.

Experience shows that this fear was unfounded.

The observations taken in 1895–96 to determine the tidal changes which have taken place in the Harlem River since the opening of the channel through Dyckmans Creek show that the velocities of existing currents through the improved cut are not at all obstructive to navigation, and are much less than those recorded either at the mouth of Spuyten Duyvil Creek or at Highbridge, Harlem River. (Annual Report of Chief of Engineers for 1896, p. 848.)

The petitioners claim that the part of the old bed of the Harlem River upon which their lands lie is not needed for navigation, and that

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the harbor lines as established by the Secretary of War exclude from use a large and valuable portion of upland embraced between them, thereby injuriously affecting their rights in said lands. The same may be said in regard to uplands adjacent to Spuyten Duyvil Creek immediately westward of Kingsbridge.

The matter has been carefully considered, and the Board is of the opinion that the improved channel through Dyckmans Creek meets all the purposes for which it was constructed, and does not need to be supplemented by any future improvement of the old reaches past Kingsbridge by the Government; that the navigation between the Hudson River and the Harlem River will be amply "preserved and protected" by the approved harbor lines passing along both banks of the Dyckman Cut, and that therefore the short portion of these lines established by the Secretary of War in 1890, which passes along the two banks of the Harlem River and Spuyten Duyvil Creek, past Kingsbridge, may be discarded without prejudice to any interest.

The utilization of lands above and below water in navigable waters adjacent to New York City is already, under State law, within the complete control of the department of docks of the city of New York, and the Board thinks, that in the present case, the matter is local in its character and may be left solely to the discretion and judgment of that department.

The Board therefore recommends that the harbor lines established by the Secretary of War October 18, 1890, on the Harlem River from the eastern end of Dyckmans Creek to Church street, Kingsbridge, and on Spuyten Duyvil Creek from Church street to the western end of Dyckmans Creek, be cancelled, and that these parts of the Harlem River and Spuyten Duyvil Creek be hereafter confided to the care of the department of docks of the city of New York under the powers vested in that department by the State.

Inclosed herewith are three briefs, filed with the Board by the following attorneys who represented parties in interest at the public hearing, namely:

1. Kellogg, Rose & Smith, attorneys for J. C. Rodgers and Edward J. Farrell, the petitioners. (Marked B.)
2. Fettretch, Silkman & Seybel, attorneys for the estate of Hugh N. Camp, deceased, and Mr. D. E. Seybel. (Marked C.)
3. Fordham Morris, attorney for the Bailey estate. (Marked D.)

Respectfully submitted.

HENRY M. ROBERT,
Colonel, Corps of Engineers.
G. L. GILLESPIE,
Colonel, Corps of Engineers.
C. W. RAYMOND,
Major, Corps of Engineers.
H. M. ADAMS,
Major, Corps of Engineers.

Brig. Gen. W. P. CRAIGHILL,
Chief of Engineers.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
January 6, 1897.

Respectfully submitted to the Secretary of War.

The New York Harbor Line Board has had under consideration a petition addressed to the Secretary of War by Messrs. J. C. Rodgers

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and Edward J. Farrell for a change in the existing harbor lines in the vicinity of their property on Harlem River.

The harbor lines which the petitioners desire to have changed were established October 18, 1890, and are located along the old bed of the Harlem River from the eastern end of Dyckmans Creek northward and westward, past Kingsbridge, and through Spuyten Duyvil Creek to the western end of Dyckmans Creek.

The Board has given careful consideration to the subject, and for the reasons stated herein is of the opinion that the lines in question may be discarded without prejudice to any interest. The Board therefore recommends that the lines established by the Secretary of War October 18, 1890, on the Harlem River from the eastern end of Dyckmans Creek to Church street, Kingsbridge, and on Spuyten Duyvil Creek from Church street to the western end of Dyckmans Creek, be cancelled, and that these parts of the Harlem River and Spuyten Duyvil Creek be left to the care of the department of docks of the city of New York under the powers vested in that department by the State.

I concur in the views and recommendations of the Board, and recommend approval thereof by the Secretary of War.

A suitable indorsement has been placed on the original map for the signature of the Secretary.

A. MACKENZIE,
Acting Chief of Engineers.

E 19.

ESTABLISHMENT OF HARBOR LINES IN EAST RIVER, NEAR THE FOOT OF EAST EIGHTY-NINTH STREET, NEW YORK CITY.

NEW YORK HARBOR LINE BOARD,
New York City, June 15, 1897.

GENERAL: The Board on Harbor Lines for New York Harbor and its Adjacent Waters having had called to their attention the gap in the bulkhead line in the vicinity of the foot of East Eighty-ninth street, East River, New York, respectfully recommends that the bulkhead line, near the foot of Eighty-ninth street, be extended as follows:

Beginning at a point 135 feet northerly of the south side of East Eighty-ninth street, and 80 feet easterly of Avenue B, and extending easterly and parallel to East Eighty-ninth street to the pierhead line established by the Secretary of War in 1890, and thence southerly along the established pierhead line until it unites with the established bulkhead line.

A lithographed map* of New York Harbor, showing proposed extension, is forwarded this date, in a separate roll.

Respectfully submitted.

HENRY M. ROBERT,
Colonel, Corps of Engineers.
G. L. GILLESPIE,
Colonel, Corps of Engineers.
C. W. RAYMOND,
Major, Corps of Engineers.
H. M. ADAMS,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers.

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*Not printed.

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[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
June 18, 1897.

Respectfully submitted to the Secretary of War.

Under date of October 18, 1890, the Secretary of War approved certain harbor lines at New York City, which action was confirmed November 5, 1891.

The attention of the Harbor Line Board for New York Harbor and its Adjacent Waters having been called to a gap in the established bulkhead line in the vicinity of East Eighty-ninth street, East River, due to inadvertence or clerical error, the Board has indicated in blue upon the accompanying chart the line which it now presents for the consideration of the Department.

It is recommended that the line selected be approved, and that the Secretary place his approval both upon this paper and upon the chart submitted, which has been prepared for his signature.

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

WAR DEPARTMENT, *June 23, 1897.*

Approved.

R. A. ALGER,
Secretary of War.

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APPENDIX F.

IMPROVEMENT OF BAY RIDGE, RED HOOK, AND BUTTERMILK CHANNELS, NEW YORK HARBOR; OF RIVERS AND HARBORS IN NEW YORK ON LONG ISLAND SOUND, ON SOUTHERN SHORE OF LONG ISLAND, AND IN NORTH-EASTERN NEW JERSEY.

REPORT OF MAJ. H. M. ADAMS, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1897, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Port Chester Harbor, New York.
2. Mamaroneck Harbor, New York.
3. East Chester Creek, New York.
4. Bronx River, New York.
5. Mattituck Harbor, New York.
6. Port Jefferson Harbor, New York.
7. Huntington Harbor, New York.
8. Glen Cove Harbor, New York.
9. Flushing Bay, New York.
10. Patchogue River, New York.
11. Browns Creek, Sayville, New York.
12. Canarsie Bay, New York.
13. Bay Ridge, Red Hook, and Buttermilk channels, New York.
14. Gowanus Creek Channel, New York.
15. Newtown Creek, New York.
16. Passaic River, New Jersey.
17. Channel between Staten Island and New Jersey.
18. Elizabeth River, New Jersey.
19. Raritan River, New Jersey.
20. South River, New Jersey.
21. Raritan Bay, New Jersey.
22. Mattawan Creek, New Jersey.
23. Keyport Harbor, New Jersey.
24. Shoal Harbor and Compton Creek New Jersey.
25. Shrewsbury River, New Jersey.
26. Removing sunken vessels or craft obstructing or endangering navigation.

EXAMINATIONS.

27. Channel connecting Flushing Bay and Newtown Creek, New York.
28. Roslyn Harbor, New York.
29. Harbor at Oyster Bay, New York.
30. Lloyds Harbor, to connect with Cold Spring Bay, New York.
31. Northport Harbor, New York.
32. Smithtown Harbor, New York.
33. Channels to Far Rockaway and Inwood, New York.
34. Babylon Creek, New York.

SURVEYS.

35. East Chester Creek, New York.
36. Bay Ridge Channel, triangular area between Bay Ridge and Red Hook channels, and Red Hook and Buttermilk channels, New York Harbor.
37. Gowanus Creek, New York.
38. Channel between the Battery and Governors Island, New York.
39. Elizabeth River, New Jersey.
40. Rahway River, New Jersey.

UNITED STATES ENGINEER OFFICE,
New York City, July 16, 1897.

GENERAL: I have the honor to transmit herewith annual report upon works of river and harbor improvement in my charge for the fiscal year ending June 30, 1897.

Very respectfully, your obedient servant,

H. M. ADAMS,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

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F 1.

IMPROVEMENT OF PORT CHESTER HARBOR, NEW YORK.

This harbor consists of the lower part of Byram River and a bay at its mouth opening into Long Island Sound. The river for about 1½ miles from its mouth forms the boundary line between the States of New York and Connecticut. It was formerly navigable to within a few hundred feet of the bridge at Port Chester, a little more than a mile above the mouth.

Before improvement the available depth up to the wharves was about 1 foot at mean low water.

A sketch of Port Chester Harbor from Salt Rock to Long Island Sound was printed in the Annual Report of the Chief of Engineers for 1889, page 716.

The mean rise of tide is 7.4 feet.

PROJECTS FOR IMPROVEMENT.

A survey of the harbor was made in 1871, and a project for improvement based on it was submitted and adopted. The project provided for the removal of two rocks, Sunken Rock, at the entrance to the bay, with 5.7 feet low-water depth, to be removed to 11 feet; and Salt Rock, about 1,000 feet above the mouth of the river, partly bare at low water, to be removed to 9 feet depth; it also provided for a breakwater 400 feet long at Byram Point. The estimated cost was as follows:

Sunken Rock, 1,474.5 cubic yards, at $40	$58,980
Salt Rock, 316.3 cubic yards, at $40	12,652
Breakwater at Byram Point	25,000
Total	96,632

This project was adopted under the river and harbor act of 1872, which appropriated money for beginning the work, with which Salt Rock was removed. The next appropriation for this harbor was made in 1882, and under a modification of the project was expended in 1884–1886 in dredging a channel 60 to 100 feet wide and 2½ feet deep at mean low water from the bay to the vicinity of the bridge at Port Chester.

In 1888 the project was further modified to omit the removal of Sunken Rock and to change the location of the proposed breakwater, making it extend from Sunken Rock to the shore at Byram Point. The rock was dangerous only because it was submerged and was at the side of the channel, which had ample width south of the rock. The end of the breakwater, on the rock, was intended to serve as a beacon, and the shelter afforded by the breakwater was also increased. On account of this modification the estimated cost of the work was in 1890 reduced to $57,000, of which $32,000 had been already appropriated and expended, the remainder, $25,000, being considered sufficient to build the breakwater and to maintain the dredged channel.

The present project for this work, therefore, consists in removing Salt Rock, building a breakwater from Sunken Rock to Byram Point, and in dredging to make and maintain a navigable channel up to the Port Chester wharves, at an estimated cost of $57,000.

At the beginning of the past fiscal year Salt Rock had been removed. The breakwater from Sunken Rock to Byram Point, 783 feet long, had been completed; the channel from the bay upward to Town Dock, a distance of about 2,300 feet, had been dredged 8 feet deep at mean low water and 75 feet wide, with greater width at the bends; above Town Dock the channel had been dredged 2½ feet deep up to the Port Chester highway bridge.

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OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

By act of Congress of June 3, 1896, $5,000 was appropriated for continuing this improvement. After duly advertising for proposals, a contract for dredging was entered into with the Newburg Dredging Company for dredging about 32,500 cubic yards of material at the rate of 13¾ cents per cubic yard, measured in scows; contract dated September 14, 1896, approved by the Chief of Engineers October 3, 1896, and expiring November 30, 1896. Dredging was begun October 9, and completed November 30, 1896, 32,500 cubic yards of mud, sand, and shells being dredged; the channel of 8 feet depth at mean low water was extended from Town Dock to the bend at the steamboat landing, a distance of about 4,000 feet, with width of 60 feet. The dredged material was deposited on private oyster grounds within 3 miles of the location of the work and outside of the channels.

PRESENT CONDITION OF IMPROVEMENT.

Salt Rock has been removed to a depth of 9 feet below mean low water. The breakwater has been built from Sunken Rock to high-water mark on the rocks at Byram Point, leaving a gap 30 feet wide near the shore end to allow small boats to pass through at high tide. The end of the breakwater has been built up to 15 feet above low water, to serve as a beacon upon Sunken Rock.

A channel 8 feet deep at mean low water has been dredged from deep water in the bay to the steamboat landing at Port Chester, a distance of 6,300 feet, with width of 75 feet up to Town Dock, and thence to the steamboat landing, 60 feet. Above the steamboat landing the depth is 2½ feet at mean low water.

PROPOSED OPERATIONS.

Future appropriations should be applied to maintaining, extending, and widening the channel.

Port Chester Harbor is in the collection district of New York. The nearest lighthouse is on Great Captains Island, 1¼ miles east of the mouth of the harbor. The nearest works of defense are the fortifications on Davids Island, New York, 9 miles to the southwest.

Money statement.

July 1, 1896, balance unexpended	$5,124.59
June 30, 1897, amount expended during fiscal year	4,938.04
July 1, 1897, balance unexpended	186.55
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

Appropriations for improving Port Chester Harbor, New York, have been made as follows:

Application.	Date.	Amount.
Removing Salt Rock	June 10, 1872	$12,000
Dredging in Byram River and Bay	Aug. 2, 1882	15,000
Breakwater	Aug. 11, 1888	5,000
Do	Sept. 19, 1890	5,000
Do	July 13, 1892	5,000
Breakwater and dredging	Aug. 17, 1894	5,000
Dredging 6 feet depth	June 3, 1896	5,000
Total		52,000

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Abstract of proposals for dredging in Port Chester Harbor, New York, opened by Maj. H. M. Adams, Corps of Engineers, Army Building, New York City, September 3, 1896.

No.	Name and address of bidder.	Price per cubic yard.	Amount of material that can be removed at the price bid.
		Cents.	*Cubic yards.*
1	A. M. Clegg, Washington, D. C.	26	17,308
2	Elijah Brainard, New York City	26¼	16,981
3	John P. Randerson, Albany, N. Y	13¾	32,432
4	Newburg Dredging Co., Newburg, N. Y. *a*	13½	32,727
5	Richard M. Payn, Albany, N. Y.	35	*b* 12,857
		66	*c* 6,818

a Lowest bidder. *b* Deposited on flats. *c* Deposited on public dumping ground.

Contract in force during fiscal year ending June 30, 1897.

Contract for dredging about 32,500 cubic yards of material, at 13½ cents per cubic yard, scow measurement: Name of contractor, The Newburg Dredging Company; date of contract, September 14, 1896; date of approval, October 3, 1896; date of beginning work, October 9, 1896; date of expiration, November 30, 1896.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

Arrival and departure of vessels.

Kind.	Number of round trips.	Draft.	Tonnage.
		Feet.	*Tons.*
Steamers	156	8	268
Steam tugs	164	5 to 8	.....
Sail vessels	56	6 to 13	60 to 125
Barges	222	3 to 10	100 to 500
Total	598	.....	.....

Freight received and shipped by water.

	Receipts.		Shipments.	
	Tons.	Estimated value.	Tons.	Estimated value.
Coal	36,521	$161,756	.....	.....
Building materials	21,665	89,310	.....	.....
Miscellaneous	34,088	1,125,915	.....	.....
Farm produce	.....	.....	2,600	$52,000
Manufactured goods, etc	.....	.....	19,875	1,024,000
Total	92,274	1,376,981	22,475	1,076,000

The above tonnage of freights received and shipped, 114,749 tons, is greater than that reported for 1895 (73,257 tons) by 41,492 tons.

No new lines of transportation have been reported established since July 1, 1896.

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F 2.

IMPROVEMENT OF MAMARONECK HARBOR, NEW YORK.

Mamaroneck Harbor, on the north shore of Long Island Sound, about 5 miles west from the Connecticut State line, consists of an open shallow bay and a narrow tidal inlet about a mile long.

The channel to the old steamboat wharf (about halfway up the inlet) had a depth of 5 feet at mean low water. From there to the upper wharves the depths gradually decreased to 1 foot. At and near its mouth the inlet was obstructed by several rocks.

The mean rise of tide at Mamaroneck is about 8 feet.

PROJECT FOR IMPROVEMENT.

A survey of the harbor was made in 1881, in pursuance of the river and harbor act of that year, and a project for improvement was submitted, and under the river and harbor act of 1882 was adopted. This project consisted in removing Round Rock, in the upper channel, to a depth of 4 feet at mean low water; in removing five other rocks (Bush Rock, part of Nells Rock, Inner Steamboat Rock, Outer Steamboat Rock, and Little Nanhook) to a depth of 7 feet, and in dredging a channel 7 feet deep and 100 feet wide from Long Island Sound to the old steamboat wharf, and thence 4 feet deep and 80 feet wide to the upper wharves, together with the closing of a small channel east of "Grassy Knoll," at a total estimated cost of $43,000.

Under the appropriation of $15,000, made in 1882, Round Rock was removed to 4 feet below mean low water and Bush Rock and Inner Steamboat Rock to 7 feet. No other work had been done up to the beginning of the past fiscal year.

A sketch of Mamaroneck Harbor was printed in the Annual Report of the Chief of Engineers for 1886, page 658.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

The river and harbor act of 1896 appropriated $10,000 for continuing the improvement of Mamaroneck Harbor. After duly advertising for and receiving proposals, a contract was entered into with James McSpirit & Sons, under date of September 12, 1896, for dredging about 46,000 cubic yards of material at the rate of 19½ cents per cubic yard, measured in scows; contract approved by the Chief of Engineers September 17, 1896, expiring November 30, 1896; subsequently extended to December 15, 1896.

A channel 60 feet wide and 6 feet deep at mean low water was dredged from deep water in the lower harbor to the upper steamboat dock, a distance of 3,000 feet, and extended 200 feet farther, with width of 35 feet. The natural depth along the channel banks was very little, the banks being bare at low tide in places, and it was necessary to dredge to 6 feet depth in order to maintain the projected depth of 4 feet.

Dredging was begun September 22 and completed December 16, 1896, 47,800 cubic yards of mud, sand, and gravel being removed.

PRESENT CONDITION OF IMPROVEMENT.

Round Rock has been removed to a depth of 4 feet at mean low water, and Bush and Inner Steamboat rocks to 7 feet depth.

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A channel 6 feet deep at mean low water has been dredged from deep water to the upper steamboat dock, 60 feet wide, and extends 200 feet further up the harbor with 30 feet width.

PROPOSED OPERATIONS.

Future appropriations should be applied to maintaining and widening the dredged channel.

Mamaroneck Harbor is in the collection district of New York. The nearest lighthouse is on Execution Rock, about 4 miles south. The nearest works of defense are the fortifications on Davids Island, New York, 5 miles to the south-southwest.

Money statement.

July 1, 1896, balance unexpended	$10,000.00
June 30, 1897, amount expended during fiscal year	9,939.46
July 1, 1897, balance unexpended	60.54
Amount (estimated) required for completion of existing project	18,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

Appropriations for improving Mamaroneck Harbor, New York, have been made as follows:

Application.	Date.	Amount.
Removal of rocks	Aug. 2, 1882	$15,000
Dredging	June 3, 1896	10,000
Total		25,000

Abstract of proposals for dredging in Mamaroneck Harbor, New York, opened by Maj. H. M. Adams, Corps of Engineers, Army Building, New York City, September 3, 1896.

No.	Name and address of bidder.	Price per cubic yard.	Amount of material that can be removed at price bid.	Remarks.
		Cents.	*Cubic yards.*	
1	A. M. Clegg, Washington, D. C.	30	30,000	
2	Elijah Brainard, New York City	19.9	45,226	
3	James McSpirit & Sons, Jersey City, N. J	19.5	46.154	
4	Richard M. Payn, Albany, N. Y.	35	25,714	Deposited on flats.
		66	13,616	Deposited on public dumping ground.

Contract in force during the fiscal year ending June 30, 1897.

Contract for dredging about 46,000 cubic yards, at 19¼ cents per cubic yard, scow measurement. Name of contractor, James McSpirit & Sons, Jersey City, N. J.; date of contract, September 12, 1896; date of approval, September 17, 1896; date of beginning work, September 22, 1896; date of expiration, November 30, 1896; extended to December 15, 1896.

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COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

Arrivals and departures of vessels.

Kind of vessel.	Number of round trips.	Draft.	Tonnage.
		Feet.	
Steamers (2)	150	7 to 8	54 to 113
Steam tugs	87	.....	.....
Sail vessels	2	9	120 to 200
Barges	78	5 to 7	100 to 450
Total	317	.....	.....

Freight received and shipped by water.

Articles.	Received.		Shipped.	
	Tons.	Estimated value.	Tons.	Estimated value.
Coal	8,600	$38,000	.....	.....
Building materials	12,795	57,092	.....	.....
Miscellaneous	7,500	375,000	.....	.....
Farm produce	.....	.....	200	$12,000
Total	28,895	470,092	200	12,000

The total tonnage of above commerce, 29,095 tons, is 4,109 tons greater than the amount reported for 1888, the last report received.

No new lines of transportation are reported established since July 1, 1896.

F 3.

IMPROVEMENT OF EAST CHESTER CREEK, NEW YORK.

East Chester Creek, called also Hutchinson River, is a small stream which, as a tidal inlet for the last 4 miles of its course, traverses marshes of one-fourth to 1 mile in width, and empties into East Chester or Pelham Bay, a large bay on the northwest shore of Long Island Sound, just east of Throgs Neck, and 20 miles by water from the Battery, New York City. The width of the creek varies from 25 feet to half a mile, at high water, but the channel is narrow everywhere.

Pelham Bridge, a highway bridge, crosses the creek near its mouth. A short distance above is the bridge and trestle of the Harlem River Branch of the New York, New Haven and Hartford Railroad, and at Lockwoods, about 2¼ miles above its mouth, the stream is crossed by the Boston road. All three bridges are drawbridges.

For half a mile up the creek there was originally a channel from 4 to 9 feet deep at low water. Farther up the depth decreased, and at Town Dock, about 1½ miles from the mouth and formerly the principal landing, the channel was about bare at low tide. Above Town Dock the stream was narrow and very crooked.

The boundaries of the city of New York, as extended in 1895, include all the lower part of East Chester Creek, to a point about one-fourth mile above Lockwoods.

The mean rise of tide is 7.1 feet.

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PROJECTS FOR IMPROVEMENT.

In 1871 a survey of East Chester Creek was ordered by Congress. The report of this survey, printed in the Annual Report of the Chief of Engineers for 1872, page 812, outlined three different plans for improvement: One for a channel 9 feet deep at mean low water, to cost $1,646,000; one for 4 feet depth at low water, to cost $731,000; and a third for a lock to secure 7 feet depth at slack water (high tide), at cost of $300,000. March 25, 1872, the House of Representatives passed a resolution inquiring the cost of removing obstructions between Tide Gauges No. 1 and No. 2, so as "to afford the same depth above Station No. 1 as now prevails below it." In reply thereto a report was submitted (see Annual Report of the Chief of Engineers for 1872, page 814) containing estimates for a channel 9 feet deep at high water and 100 feet wide up to a point 3,000 feet above Lockwoods, the location of the tidal station referred to, to be secured by construction of a tidal basin, dredging, and diking, at a cost of $136,505. This plan contemplated abandoning the crooked natural course of the stream, and, as it was necessary in any case to replace the old arch bridge of the Boston road at Lockwoods with a drawbridge, changing the location about 700 feet eastward to straighten the channel.

This project was adopted March 3, 1873, when Congress appropriated $25,000 for beginning work. The proposed change in position of the bridge at Lockwoods was abandoned, as the towns concerned would not give their consent, and a drawbridge was built on the site of the old bridge. This necessitated a change in the proposed layout of the channel, and involved rock excavation estimated to cost $10,000. Work under this project was not begun until 1877, being delayed until a commission appointed by the State of New York had obtained the lands for the proposed cut. In 1878 the project was extended to include the removal of a shoal of bowlders just outside of Pelham Bridge and the excavation of a channel 125 feet wide on the west side of Goose Island above the railroad bridge. Revised estimates of cost were submitted in 1891, omitting the tidal basin and part of the proposed diking, which seemed unnecessary, and making the total cost $124,000.

The project of 1873, as thus modified, consists in making a channel 100 feet wide and 9 feet deep at mean high water (about 2 feet at low water), extending from Pelham Bay up the creek to 3,000 feet above Lockwoods, and in removing rocky obstructions from the mouth of the creek, at an estimated cost of $124,000.

Up to July 1, 1896, the rocky obstructions at the mouth of the creek had been removed, and a channel 9 feet deep at mean high water had been carried to a point 3,000 feet above Lockwoods. The width of the Channel was 100 feet or over, except between Town Dock and Lockwoods, a distance of about half a mile, where the 9-foot channel was very narrow.

A sketch of East Chester Creek was printed in the Annual Report of the Chief of Engineers for 1893, page 968.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

The river and harbor act of June 3, 1896, appropriated $10,000 for continuing this improvement, and an act of Congress, approved February 17, 1897, authorized the Secretary of War, in his discretion, to expend the whole or any portion of any appropriation heretofore made

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for the improvement of East Chester Creek "upon that portion of the improvement included in recent surveys extending the improvement to the head of tide water." In accordance therewith a project was submitted proposing the application of the available funds to "dredging out the shoals in the channel and to removing rock from the rock-cut below Lockwoods, and should any balance remain after providing for this work, to extending the channel of 100 feet width and 9 feet depth at mean high water toward the head of tide water, provided the right of way for such extension and for deposits of dredged materials upon the banks be furnished free of cost to the United States." This project was approved by the Secretary of War March 16, 1897.

After advertising for proposals a contract was entered into with James McSpirit, for dredging and rock excavation, amounting to about 16,515 cubic yards, at prices for dredging sand, 41 cents per cubic yard; for dredging loose rock and sand mixed, $1.09 per cubic yard; for removing solid rock, $19 per cupic yard. This contract is dated June 7, 1897. It was approved by the Chief of Engineers June 15, 1897, and expires October 1, 1897. Work under it has not yet been begun.

PRESENT CONDITION OF IMPROVEMENT.

There is now a channel of about 9 feet depth at high water from Pelham Bridge to a point 3,000 feet above Lockwoods, 100 feet wide for all the distance except between Town Dock and Lockwoods, where it is from 20 to 50 feet less width.

The dikes on the east side of the cut below Lockwoods, built in 1877–78, show some deterioration. No repair is necessary at present.

PROPOSED OPERATIONS.

Under the existing contract it is proposed to deepen the channel between Town Dock and Lockwoods, making a width of 100 feet as nearly as may be. Should any funds remain after doing this, it is proposed to extend the channel above its present limit, 3,000 feet above Lockwoods, as authorized by act of Congress approved February 17, 1897.

This work will complete all that is now required under the existing project for improvement.

East Chester Creek, New York, is in the collection district of New York. The nearest light-house is on the "Stepping Stones," 3 miles southeast of the mouth of the creek. The nearest work of defense is Fort Schuyler, Throgs Neck, about 3½ miles south.

Money statement.

July 1, 1896, balance unexpended		$10,452.99
June 30, 1897, amount expended during fiscal year		68.25
July 1, 1897, balance unexpended		10,384.74
July 1, 1897, outstanding liabilities	$25.00	
July 1, 1897, amount covered by uncompleted contracts	9,000.00	
		9,025.00
July 1, 1897, balance available		1,359.74

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Appropriations for improving East Chester Creek have been made as follows:

Application.	Date.	Amount.
Cutting through marsh and rock, and diking (in 1877)	Mar. 3, 1873	$25,000
Dredging under Boston Road Bridge and at Goose Island	Mar. 3, 1875	12,000
Dredging near Lockwoods, Goose Island, and Pelham Bridge	June 18, 1878	10,000
Dredging, from 40 to 90 feet wide, from Pell Point to Town Dock	Mar. 3, 1879 June 14, 1880	3,500 3,500
Dredging above Town Dock	Aug. 5, 1886	10,000
Dredging above Lockwoods	Aug. 11, 1888	5,000
Do	Aug. 17, 1894	12,000
Dredging (work in progress)	June 3, 1896	10,000
Total		91,000

Abstract of proposals for improving East Chester Creek, New York, opened by Maj. H. M. Adams, Corps of Engineers, New York, May 26, 1897.

No.	Name and address of bidder.	Sand, mud, etc., 15,000 cubic yards.		Loose rock, 1,500 cubic yards.		Solid rock, 15 cubic yards.		Total bid.
		Per cubic yard, in scows.	Total bid.	Per cubic yard, in scows.	Total bid.	Per cubic yard, in place.	Total bid.	
1	Alonzo E. Smith, Islip, N. Y.	$0.50	$7,500	$1.50	$2,250	$20	$300	$10,050
2	Frank Pidgeon, Saugerties, N. Y.	.45	6,750	2.85	3,420	40	600	10,770
				In place (1,200 cubic yards).				
3	James McSpirit, 122 Wayne street, Jersey City, N. J.	.41	6,150	1.09	1,635	19	285	8,070

Amount available, $9,000.
Lowest bidder; recommended for acceptance.

Contract in force during the fiscal year ending June 30, 1897.

Contract, dredging and rock excavation: Mud, sand, etc., about 15,000 cubic yards, at 41 cents per cubic yard, scow measurement; solid rock, about 15 cubic yards, at $19 per cubic yard, measured in place; loose rock, about 1,500 cubic yards, at $1.09 per cubic yard, measured in scows. Name of contractor, James McSpirit, of Jersey City, N. J.; date of contract, June 7, 1897; date of approval, June 15, 1897; date of beginning, not yet begun; date of expiration, October 1, 1897.

Commercial statistics for the calendar year 1896 have been asked for, but none were received. Following is a statement of the commerce, by water, for calendar year 1895:

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1895.

Arrivals and departures of vessels.

[Draft, 6 to 10 feet; tonnage, 200 to 300 tons.]

Steamers	544
Sail vessels	27
Barges	230
Total	801

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Freight received and shipped by water.

Articles.	Tons.	Estimated value.
Coal	16,878	$84,390
Building materials	7,580	50,900
Miscellaneous steamer freights, ashes, asphalt, crushed stone, etc	70,470	2,063,896
Total	94,928	2,199,186

The above figures show a decrease in tonnage of freights of 42,340 tons below the amount reported for 1894.

No new lines of transportation have been established since July 1, 1895.

F 4.

IMPROVEMENT OF BRONX RIVER, NEW YORK.

The Bronx River is a small stream which flows southwardly through Westchester County and discharges into the East River, New York, about halfway between Hell Gate and Throgs Neck. For the lower 3 miles of its course up to West Farms the river is a tidal stream navigable at high water. This part of the Bronx River lies wholly within the boundaries of New York City. Excepting a small bay at the mouth, the stream is everywhere narrow, with widths ranging from 50 to 300 feet. The natural depth in the bay is about 4 feet at mean low water, decreasing to 1 foot or less at the West Farms Docks. A short distance above these docks there is a dam which wholly limits navigation.

The navigable part of the river is crossed by two bridges, both with draws; the lower one is a highway bridge, about 2¼ miles above the mouth of the bay; 600 feet above is the bridge of the New York, New Haven and Hartford Railroad, Harlem River Branch.

The mean rise of tide in the bay is 6.6 feet; at West Farms it is 5.9 feet.

PROJECT FOR IMPROVEMENT.

The river and harbor act of 1880 provided for a survey of the Bronx River. The report on the survey presented plans for making a channel 30 feet wide and 4 feet deep, at an estimated cost of $42,000. No appropriation was made for beginning work.

A survey of the Bronx River was again made in compliance with the provisions of the river and harbor act of 1890, the report upon which, printed in the Annual Report of the Chief of Engineers for 1891, page 951, presented a project for improvement which was adopted under the terms of the river and harbor act of 1896. This project consists in dredging and removal of rock to make a navigable channel 4 feet deep at mean low water, to be 100 feet wide from the entrance (Strain place) to Barlow street, thence to Dongan street to be 60 feet wide, and thence to the head of navigation at West Farms to be 50 feet wide, at an estimated cost of $85,985.

Harbor lines in the bay at the mouth of Bronx River were established by the Secretary of War January 9, 1891.

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OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

By act of Congress of June 3, 1896, $10,000 was appropriated for this improvement, and a project for its expenditure, approved by the Secretary of War July 24, 1896, was adopted, providing for the removal of certain rocks in the lower part of the channel. After advertising for and receiving proposals, a contract was entered into with Frank Pidgeon for removing about 1,300 cubic yards of rock, at $6.89 per cubic yard; contract dated September 28, 1896, approved by the Chief of Engineers October 12, 1896, expiring June 30, 1897, extended to July 31, 1897. The contract provided that the excavated rock should be placed upon a scow, that the displacement due to the load should be measured, and that 70 cubic feet of displaced salt water should be considered equivalent to 1 cubic yard of rock.

Work under this contract was begun in October, 1896. The drilling was done with a steam drill mounted on a wooden platform, which was moved from place to place by a pile driver. The holes were made with a 2-inch drill, and were generally placed at intervals of about 4 feet and drilled to 3 or 4 feet below the required plane of removal. Explosive used, 40 and 60 per cent dynamite, in charges of one-half to 3 or 4 pounds, varying with the depth of the drill hole. The blasted rock was taken up by a dredge employed at occasional intervals for the purpose. A small part of it was taken away for dock filling, and the rest was placed upon marsh lands near by.

During the past fiscal year 1,126.37 cubic yards of rock has been removed, nearly completing the required work upon three rocks in the lower part of the stream.

PRESENT CONDITION OF IMPROVEMENT.

Three rocks below the bend in the river, between the railroad and highway bridges, have been deepened so as to have an available depth of 6 feet at mean low water; the channel depth up to that point, where the bottom is muddy, is about 3 feet. Above the railroad bridge no work has been done, and the available depth is from zero to 2½ feet.

PROPOSED OPERATIONS.

Under the existing contract the three worst ledges in the lower part of the stream will be removed to a depth of 6 feet at mean low water, so as to make a channel width of 50 feet or over.

Future appropriations should be applied to the dredging and rock removal proposed under the project.

The Bronx River is in the collection district of New York. The nearest light-house is on North Brother Island, about 2 miles west from the mouth of the river. The nearest work of defense is Fort Schuyler, Throgs Neck, New York.

Money statement.

July 1, 1896, balance unexpended		$10,000.00
June 30, 1897, amount expended during fiscal year		2,498.91
July 1, 1897, balance unexpended		7,501.09
July 1, 1897, outstanding liabilities	$6,648.89	
July 1, 1897, amount covered by uncompleted contracts	851.81	
		7,500.70
July 1, 1897, balance available		.39
Amount (estimated) required for completion of existing project		75,985.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

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The only appropriation made by Congress for this improvement is that of $10,000 made by the river and harbor act of 1896.

Abstract of proposals for removing rock from Bronx River, New York, opened by Maj. H. M. Adams, Corps of Engineers, at New York City, September 15, 1896.

No.	Name and address of bidder.	Price per cubic yard of rock.	Amount that can be removed ($9,000).	Remarks.
1	W. Stammers Brown, 137 West Ninety-third street, New York City	$14.90	604	
2	P. Sanford Ross, 277 Washington street, Jersey City, N. J.	8.90	1,011	
3	Wm. H. Virden and John C. Ross, Lewes, Del.	11.25	800	
4	Frank Pidgeon, Saugerties, N. Y.	6.89	1,306	Lowest bid.
5	Richard A. Monks, 130 Water street, New York City.	11.48	784	

Contract in force during the fiscal year ending June 30, 1897.

Contract for rock removal: About 1,300 cubic yards, at $6.89 per cubic yard, solid. Name of contractor, Frank Pidgeon, of Saugerties, N. Y.; date of contract, September 28, 1896; date of approval, October 12, 1896; date of beginning work, October 17, 1896; date of expiration, June 30, 1897, extended to July 31, 1897.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

Arrivals and departures of vessels.

[Draft 3½ to 7 feet.]

Kind of vessels.	Number of round trips.	Aggregate tonnage of all trips.
Steamers	3	191
Sailing vessels	111	12,901
Barges, canal boats, etc	465	28,407
Total	579	91,499

Freight received and shipped by water.

Articles.	Tons.	Estimated value.
Coal	67,627	$284,608
Building materials	26,117	167,295
Miscellaneous	500	2,500
Total	94,244	454,403

The last previous report was for 1890, when 221,250 tons of freight was reported. The above figures show a decrease below the report of 1890 of 127,006 tons.

No new lines of transportation have been established since July 1, 1896.

F 5.

IMPROVEMENT OF MATTITUCK HARBOR, NEW YORK.

Mattituck Harbor, on the south shore of Long Island Sound, near its eastern end and about 70 miles east from New York City, is a tidal inlet extending up to the village of Mattituck, about 2¼ miles from the Sound. The lower part of the stream runs in a rather crooked course

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through salt meadows, and is generally from 100 to 200 feet wide. A mile above the mouth a causeway has been built across the marsh and a tide milldam with gates across the stream. When the tide gates are closed slack high water prevails in the stream above them.

The entrance channel has a natural depth of from 1 to 2 feet at mean low water across a sand bar which changes with each heavy storm, shifting the channel from east to west and back. Inside the entrance, up to the dam the low-water depths range from 2 to 7 feet, and above the dam the high-water depth is nearly 6 feet.

The mean rise of tide in Long Island Sound at the mouth of the harbor is 4.8 feet; this decreases to 2.2 feet just below the dam, while above the dam, when the gates are shut, the observed rise of tide is only about 2 inches.

PROJECT FOR IMPROVEMENT.

In pursuance of the river and harbor act of 1890 a preliminary examination of Mattituck Bay was made, the report upon which, printed in the Annual Report of the Chief of Engineers for 1891, page 843, outlined a plan for improvement, with estimate of cost, and stated that no further survey was required.

The river and harbor act of 1896 appropriated $10,000 for "improving harbor at Mattituck, New York, according to the project submitted in the Annual Report of the Chief of Engineers for 1891." The project thus adopted consists in making a channel of 7 feet depth at mean low water, to be 100 feet wide at the entrance, and thence to the milldam to be 80 feet wide, and extending the same to the village of Mattituck with depth of 7 feet at high water and 80 feet width, the entrance channel to be protected by parallel jetties, at a total estimated cost of $83,000.

No work has yet been done under this project.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

Nothing has been done. The first work necessary under the project for this improvement is the construction of the parallel jetties to protect and fix the shifting channel. The construction of these two jetties was estimated to cost about $40,000, and the available funds would be sufficient to build about one-half of either, from which no benefit to navigation could result. Therefore, with approval of the Secretary of War, dated February 12, 1897, the project for the application of the funds provided for Mattituck Harbor was modified to permit of their retention until a sufficient sum is appropriated to complete at least one of the jetties.

PROPOSED OPERATIONS.

For the reason above stated no work is at present proposed.

Mattituck Harbor is in the collection district of New York. The nearest lighthouse is on Hortons Point, about 8 miles to the northeast. The nearest work of defense is Fort Hale, New Haven Harbor, Connecticut, about 25 miles northwest.

Money statement.

July 1, 1896, balance unexpended	$10,000.00
July 1, 1897, balance unexpended	10,000.00
Amount (estimated) required for completion of existing project	73,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

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Appropriation for improving Mattituck Harbor, New York, $10,000, by act of June 3, 1896; not yet expended.

No contract in force during the past fiscal year.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

No statement of amount or tonnage of freights by water has been received. The harbor in its present condition is navigated only by boats of very light draft, and even this is done with difficulty.

The greater part of the freighting to and from Mattituck, estimated at about 100,000 tons in 1896, is done by rail.

F 6.

IMPROVEMENT OF PORT JEFFERSON HARBOR, NEW YORK.

Port Jefferson Harbor is on the north shore of Long Island and about 50 miles east from New York City. It is 2 miles long and averages three-fourths of a mile wide, and a large part of the area has a depth of 18 feet or more at low tide. Tributary to this harbor on the west are Setauket Harbor and Conscience Bay, two shallow tidal basins. Port Jefferson Harbor is surrounded on three sides by hills, and is separated from Long Island Sound on the north by a beach of sand and gravel, through which, and nearly in the axis of the harbor, is a single entrance 400 feet wide. This entrance is Port Jefferson Inlet, and through it a tidal reservoir of 2 square miles area receives and discharges some 300,000,000 cubic feet of water with every tide, producing a current whose maximum velocity exceeds 4 miles per hour. In the narrow part of the inlet the depths have always been considerable, but a short distance out into the Sound was a broad, flat bar, which originally had a depth of 4 feet at low water. Until the beginning of Government improvement in 1871 the location of the inlet had been shifting; since 1838 it has moved westward 790 feet, an average annual rate of 24 feet.

The village of Port Jefferson, with a population of about 3,000, lies at the head or south end of the harbor. The mean rise of tides at the village wharves is 6.2 feet; in Long Island Sound outside the inlet it is 7 feet. The difference is wholly in low-water levels.

PROJECTS FOR IMPROVEMENT.

In 1870 an examination of this harbor was made under authority of Congress, and a plan for improvement was submitted, which was adopted under the river and harbor act of 1871, making appropriation for beginning the work. This project, as subsequently modified, consisted in building riprap jetties to protect either side of the inlet, the east jetty to be 1,390 feet long and the west jetty 940 feet, and in dredging a channel between them 100 feet wide and 8 feet deep at mean low water, at an estimated cost of $79,000. Work was begun in 1871, and in 1883, after $79,000 had been appropriated and expended, the project was completed.

The river and harbor act of 1888 ordered a preliminary examination of Port Jefferson Inlet. The report on this examination, printed in the Annual Report of the Chief of Engineers for 1889, page 751, stated that no survey was necessary, and presented plans for improvement to make 10 feet depth at a cost of $90,000, or 12 feet depth at a cost of

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$145,000. Under the river and harbor act of 1890 the project for 10 feet depth was adopted, and in compliance with the terms of the river and harbor act of 1894 it was modified to the 12-foot project. The present adopted project, therefore, consists in dredging a channel through the harbor entrance, to be 12 feet deep at mean low water and 200 feet wide, and in protecting the channel by enlarging and extending the previously built jetties or breakwaters at a cost of $145,000.

Up to July 1, 1896, the east jetty had been partly enlarged and 250 feet of the outer end of the west jetty had been strengthened; the inlet channel had been dredged 240 feet wide and 10 feet deep at mean low water, and 100 feet width of this channel had been further deepened to 12 feet.

A sketch of Port Jefferson Inlet, the entrance to the harbor, was printed in the Annual Report of the Chief of Engineers for 1886, page 660.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

Under the appropriation of $7,500, made by the river and harbor act of 1896, after duly advertising for proposals, a contract for dredging to remove shoals and to widen the 12-foot channel was entered into with the Newburgh Dredging Company, of Newburg, N. Y., at the rate of 23⅞ cents per cubic yard measured in scows; contract dated March 22, 1897, approved by the Chief of Engineers April 2, 1897, and expiring August 31, 1897. Dredging under this contract was begun May 13, and up to the close of the fiscal year 27,282 cubic yards of sand and stones had been removed, widening the 100-foot channel of 12 feet depth by 60 to 80 feet, and removing part of a shoal found in the previously dredged channel. The contract is nearly completed; there remains only the deepening of two small shoals.

PRESENT CONDITION OF IMPROVEMENT.

The east jetty is 1,390 feet long, part of the shore end being covered by sand which has drifted in; it is 6 feet above high-water level, and approximately 4 feet wide on top. The west jetty is 940 feet long; the outer 250 feet has been built up to about 4 feet above high water, with 4 feet top width; the inner part is about 2 feet above low water. Both jetties are rough and in an unfinished condition; they require building up, trimming, and filling out the side slopes.

The dredged channel, made 240 feet wide and 10 feet deep, has shoaled on the east side at the inner end and is now about 200 feet wide. The 12-foot channel, now 160 to 180 feet wide, lies within and on the west side of the 10-foot channel.

PROPOSED OPERATIONS.

Under the contract now in progress, the 12-foot channel has been made 160 to 180 feet wide throughout the harbor entrance.

With future appropriations it is proposed to repair and enlarge the jetties as provided for in the adopted project, and to maintain the dredged channel.

Port Jefferson is a port of delivery in the collection district of New York. There is a light-house on Old Field Point 1¼ miles west of the harbor entrance. Fort Hale, New Haven Harbor, Connecticut, 23 miles distant, is the nearest work of defense.

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Money statement.

July 1, 1896, balance unexpended		$8,297.24
June 30, 1897, amount expended during fiscal year		2,275.58
July 1, 1897, balance unexpended		6,021.66
July 1, 1897, outstanding liabilities	$4,735.46	
July 1, 1897, amount covered by uncompleted contracts	287.69	
		5,023.15
July 1, 1897, balance available		998.51
Amount (estimated) required for completion of existing project		95,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

Appropriations for improving Port Jefferson Harbor have been made as follows:

Application.	Date.	Amount.
For previous projects:		
East jetty	Mar. 3, 1871	$15,000
Do	June 10, 1872	15,000
East and west jetties	Mar. 3, 1875	15,000
East jetty and dredging	Aug. 14, 1876	6,000
East and west jetties	June 18, 1878	8,000
Dredging	Mar. 3, 1879	5,000
East and west jetties	June 14, 1880	3,000
East jetty	Mar. 3, 1881	4,000
Do	Aug. 2, 1882	8,000
Total for the previous projects		79,000
For the present project:		
Enlarging jetties and dredging	Sept. 19, 1890	25,000
Dredging 10 feet deep	July 13, 1892	10,000
Dredging 12 feet deep	Aug. 17, 1894	7,500
Under contract for dredging 12 feet deep	June 3, 1896	7,500
Total for present project		50,000
The total amount appropriated for this harbor since 1871 is		129,000

Abstract of proposals for dredging in Port Jefferson Harbor, New York, opened by Maj. H. M. Adams, Corps of Engineers, New York City, March 12, 1897.

Name and address of bidder.	Rate per cubic yard, scow measure.	Number of cubic yards to be removed under price bid.	Remarks.
	Cents.		
R. G. & J. S. Packard, 130 Pearl street, New York City	29½	23,051	
Newburgh Dredging Co., Newburg, N. Y	23¾	28,482	Lowest bid.
Hartford Dredging Co., Hartford, Conn	39	17,437	
J. H. Fenner, Jersey City, N. J	28	24,286	
Elijah Brainard, 24 State street, New York City	32	21,250	

Contract in force during the fiscal year ending June 30, 1897.

Contract for dredging about 28,400 cubic yards, at 23¾ cents per cubic yard, measured in scows; name of contractor, Newburg Dredging Company, of Newburg, N. Y.; date of contract, March 22, 1897; date of approval, April 2, 1897; date of beginning work, May 13, 1897; date of expiration, August 31, 1897.

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COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

Arrivals and departures of vessels.

[Draft, 4 to 16 feet; tonnage, 13 to 950 tons.]

Kinds of vessels.	Number of round trips.	Aggregate tonnage of all trips.
Steamers	750	53,500
Sailing vessels	770	44,500
Total	1,520	98,000

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Receipts:		
Coal	10,000	$50,000
Lumber	2,500	50,000
Grain	3,000	60,000
Miscellaneous	6,200	465,000
Shipments:		
Flour, rubber goods, farm produce, wood, and miscellaneous	10,000	250,000
Total	31,700	875,000

Vessels built and repaired during 1896.

Kinds of vessels.	Number of vessels.	Tonnage.
Steamers	2	172
Sailing vessels	1	24
Repaired steamers	22	1,464
Repaired sailing vessels	104	5,720
Vessels making winter quarters in this harbor, 1896–97	96	6,330

The above figures show a decrease in reported tonnage of freights since the previous year of 4,300 tons.

No new lines of transportation have been established since July 1, 1896.

F 7.

IMPROVEMENT OF HUNTINGTON HARBOR, NEW YORK.

Huntington Harbor is a landlocked basin about 2 miles long and a quarter of a mile wide, extending in a crooked but generally southerly direction from Huntington Bay, from which it is separated by a beach of sand and gravel, through the western end of which a narrow inlet (about 300 feet wide) connects the harbor and the bay.

The bay is a large, deep harbor of refuge on the north shore of Long Island, about 40 miles east from New York City. The harbor has an available depth of about 8 feet at mean low water through the entrance and more than halfway up, but in the three-quarters of a mile nearest the head or south end of the harbor the original channel was narrow and decreasing in depth to zero at low tide.

Huntington village lies about a mile south of the head of the harbor; it has 4,000 to 5,000 population.

The mean rise of tide is 7.2 feet.

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PROJECTS FOR IMPROVEMENT.

By act of Congress of March 3, 1871, a survey of Huntington Harbor was ordered. The report on the survey, printed in the Annual Report of the Chief of Engineers for 1872, page 907, submitted a plan for improvement by dredging out a shoal at the harbor entrance and extending the 8-foot channel with 150 feet width for about 2,000 feet up to the old town dock. The project was adopted June 10, 1872, when $22,500 was appropriated for the work, and with this sum the project was completed in 1873, the extension of channel being 2,200 feet, and the width of 150 feet being reduced to 130 feet for the upper 900 feet of the channel.

Under authority of the river and harbor act of 1884 a survey of the harbor was made. This survey showed that the channel, dredged in 1872–73, had completely filled up, and a plan for restoring and maintaining it was submitted, at an estimated cost of $32,000. This project was adopted in 1890, when an appropriation was made for beginning the work. It was designed to maintain the channel, after dredging, by a pile protection along its west edge, but this met with much local opposition on the ground of limiting the high-water channel; it is believed that equally good results can be obtained by dredging from time to time to maintain the projected width, and at a cost not exceeding that for pile protection. The adopted project consists in making and maintaining by dredging and, if necessary, pile protection, a channel 100 feet wide and 8 feet deep at mean low water up to and beyond the old town dock.

At the beginning of the past fiscal year the 8-foot channel had been made 125 feet wide up to the bend at the old town dock, 185 feet wide at the bend, and 90 feet wide for about 500 feet above the bend.

A sketch of the upper part of Huntington Harbor was printed in the Annual Report of the Chief of Engineers for 1893, page 976.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

Under the appropriation of $5,000, made by the river and harbor act of 1896, after duly advertising for proposals, a contract was entered into with Elijah Brainard for widening the 8-foot channel and removing shoals, by dredging about 47,000 cubic yards of material at 9½ cents per cubic yard; contract dated March 25, 1897, approved by the Chief of Engineers April 2, 1897, and expiring August 31, 1897.

Dredging under this contract was begun May 3 and completed June 19, 1887; the total amount dredged was 47,050 cubic yards. Shoals in the old channel were removed and the channel was widened to the westward by 40 feet.

The material removed was mud in the lower part; in the upper part it was sand, overlaid in places with mud. The shoals found in and along the edge of the previous channel were of very soft mud.

PRESENT CONDITION OF IMPROVEMENT.

The dredged channel has been made 175 feet wide up to the bend at the old town dock, 230 feet wide at the bend, and about 100 feet wide for about 200 feet above the bend, the width over 100 feet being made for purposes of maintenance, in lieu of piling; the depth made has been 8 feet below mean low water.

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PROPOSED OPERATIONS.

It is proposed to apply future appropriations to maintaining the channel.

Huntington Harbor is in the collection district of New York. The nearest lighthouse is on Eatons Point, at the east side of the mouth of Huntington Bay, about 4 miles distant from the harbor. The nearest works of defense are the fortifications at Willets Point, about 20 miles westward.

Money statement.

July 1, 1896, balance unexpended	$5,151.74
June 30, 1897, amount expended during fiscal year	4,831.97
July 1, 1897, balance unexpended	319.77
July 1, 1897, outstanding liabilities	95.83
July 1, 1897, balance available	223.94
Amount (estimated) required for completion of existing project	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

Appropriations for improving Huntington Harbor have been made as follows:

Application.	Date.	Amount.
For a previous project:		
Dredging	June 10, 1872	$22,500
For the present project:		
Dredging	Sept. 19, 1890	10,000
Do	July 13, 1892	5,000
Do	Aug. 17, 1894	2,000
Do	June 3, 1896	5,000
Total for present project		22,000
Total for Huntington Harbor, both projects		44,500

Abstract of proposals for improving Huntington Harbor, New York, opened by Maj. H. M. Adams, Corps of Engineers, New York City, March 12, 1897.

Name and address of bidder.	Rate per cubic yard, scow measurement.	Number of cubic yards to be removed under price bid.	Remarks.
	Cents.		
Newburg Dredging Co., Newburg, N. Y.	12	37,500	
Elijah Brainard, 24 State street, New York City	9½	47,368	Lowest bid.

Contract in force during the fiscal year ending June 30, 1897.

Contract for dredging about 47,000 cubic yards, at 9½ cents per cubic yard, measured in scows. Name of contractor, Elijah Brainard, of New York City; date of contract, March 25, 1897; date of approval, April 2, 1897; date of beginning work, May 3, 1897; date of expiration, August 31, 1897.

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COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

Arrivals and departures of vessels.

[Draft, 4 to 15 feet; tonnage, 50 to 450 tons.]

Kinds of vessels.	Number of round trips.	Aggregate tonnage of all trips.
Steamers	308	77,000
Sail vessels	680	136,000
Barges, etc	25	25,000
Total	1,013	238,000

Freights received and shipped by water.

Articles.	Received.		Shipped.	
	Tons.	Value.	Tons.	Value.
Coal	6,000	$24,000		
Building materials	14,000	350,000		
Farm produce, etc			27,000	$405,000
Miscellaneous	26,350	395,250		
Total	46,350	769,250	27,000	405,000

The above figures show a total of 73,350 tons, valued at $1,174,250, being an increase of 3,350 tons over the amount reported for 1895.

No new lines of transportation are reported as established since July 1, 1896.

F 8.

IMPROVEMENT OF GLEN COVE HARBOR, NEW YORK.

Glen Cove Harbor is a small estuary or creek opening into the east side of Hempstead Harbor, Long Island, about 1¾ miles from Long Island Sound and about 27 miles by water from the Battery, New York City. The channel in the creek is about 2 feet deep at mean low water, and a bar at the entrance has a foot less depth. Vessels entering Glen Cove Harbor have to wait for high tide, anchoring in Hempstead Harbor, where they are exposed to storms from the north and northwest. When such storms are heavy it is impossible to tow over the bar, and from this cause vessels have been obliged to remain in the bay for three or four days exposed to heavy seas.

The mean rise of tide in this harbor is 7.7 feet.

PROJECT FOR IMPROVEMENT.

The river and harbor act of 1886 provided for a survey or examination of Glen Cove Harbor. An examination was all that was deemed necessary, and the report upon this, printed in the Annual Report of the Chief of Engineers for 1887, page 645, presented a project for sheltering vessels outside the entrance to Glen Cove Harbor by building a breakwater. This project was adopted in 1888, when Congress appropriated funds for beginning work, and it consisted in constructing a breakwater in Hempstead Harbor to shelter the anchorage outside Glen Cove Harbor, to be about 2,500 feet long, 3 feet above high water, with top width of 5 feet, and to extend from the northwest corner of Glen Cove Dock west southwestwardly toward Motts Point, at an estimated cost of $201,960. In 1895 this project was modified to reduce the length of the breakwater to about 2,000 feet and the estimated cost to $135,000.

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July 1, 1896, 1,289 linear feet of the breakwater had been built, the top being made 4 feet above high water and 3 feet wide.

A sketch of part of Hempstead Harbor, showing the Glen Cove Harbor improvement, was printed in the Annual Report of the Chief of Engineers for 1889, page 728.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

Under the appropriation made by the river and harbor act of 1896, after advertising for proposals, a contract for extending and repairing the breakwater was entered into with J. Frank Quinn, of New York City, providing for furnishing and delivering in place about 11,800 tons of riprap, at the rate of fifty-nine cents per gross ton; contract dated September 25, 1896, approved by the Chief of Engineers September 30, 1896, and expiring December 31, 1896. This contract was extended to March 31, 1897, and subsequently to April 30, 1897, on which day it was completed.

The amount of riprap delivered in the breakwater under this contract was 11,845 tons, of which 1,040 tons was used in repairing the old work and 10,805 tons in extending the breakwater. The breakwater was extended 176 linear feet, built to a height of 4 feet above mean high water, with a top width of 3 feet and side slopes of 1 upon 1.

The stone used was a hard gneiss selected from excavations in New York City, which can be obtained at some seasons, delivered upon the docks in New York City, at little or no cost. The price bid is but little over a fair price for transporting and placing the stone.

The breakwater now ends in a depth of water of 22 feet at mean low water; the bottom is of soft mud about 6 feet deep, overlying sand.

A small red light has been maintained upon the end of the uncompleted breakwater during the year. The expense of this was borne by the contractor during the period of his work, as provided for in the contract.

PRESENT CONDITION OF IMPROVEMENT.

The breakwater is now 1,465 feet long, with 3 feet top width at a level of 4 feet above mean high water. It has settled slightly in places. The work contains about 80,580 tons of riprap.

At its present length the breakwater affords a shelter to vessels waiting for tide to enter Glen Cove Harbor, and also to local commerce at the Glen Cove dock.

PROPOSED OPERATIONS.

Future appropriations should be applied to the extension of the breakwater under the adopted project.

Glen Cove Harbor is in the collection district of New York. The nearest lighthouse is on Sands Point, about 4 miles west. Fort Schuyler, New York Harbor, is the nearest work of defense.

Money statement.

July 1, 1896, balance unexpended	$8,499.90
June 30, 1897, amount expended during fiscal year	7,929.64
July 1, 1897, balance unexpended	570.26
July 1, 1897, outstanding liabilities	16.00
July 1, 1897, balance available	554.26
Amount (estimated) required for completion of existing project	72,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

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Appropriations for improving Glen Cove Harbor, New York, have been made as follows:

Application.	Date.	Amount.
Breakwater construction	Aug. 11, 1888	$20,000
Do	Sept. 19, 1890	15,000
Do	July 13, 1892	10,000
Do	Aug. 17, 1894	10,000
Do	June 3, 1896	8,000
Total		63,000

Abstract of proposals for extending and repairing breakwater at Glen Cove Harbor, New York, opened by Maj. H. M. Adams, Corps of Engineers, New York City, September 5, 1896.

Name and address of bidders.	Rate per ton of 2,240 pounds.	Number of tons under price bid.	Remarks.
	Cents.		
S. & E. S. Belden, Hartford, Conn	73	9,589	
Andrew A. Bouker, 110 Wall street, New York City	62½	11,200	
J. Frank Quinn, 232 East Thirty-first street, New York City	59	11,864	Lowest bid.

Contract in force during the fiscal year ending June 30, 1897.

Contract: Extension and repair of breakwater, about 11,800 tons of riprap, at 59 cents per gross ton, delivered and placed. Name of contractor, J. Frank Quinn, of New York City; date of contract, September 25, 1896; date of approval, September 30, 1896; date of beginning work, October 22, 1896; date of expiration, December 31, 1896; extended to March 31, 1897, and subsequently to April 30, 1897.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

Arrivals and departures of vessels.

[Draft, 3 to 12 feet; tonnage, 20 to 225 tons.]

Kind of vessel.	Number of round trips.	Aggregate tonnage of all trips.
		Tons.
Steamers, steam tugs, and yachts	850	106,900
Sailing vessels	234	26,700
Barges	550	122,750
Total	1,634	256,350

Freight received and shipped by water.

Chief articles.	Tons	Estimated value.
Receipts:		
Coal	32,926	$84,080
Corn	34,134	426,676
Building materials	2,000	25,000
Miscellaneous	15,451	331,179
Shipments:		
Starch, glucose, etc	20,394	1,069,899
Miscellaneous	1,530	71,100
Total	106,435	1,987,934

These figures show a decrease in tonnage of freights since the last report received (1893) of 198,565 tons.

No new lines of transportation have been reported established since July 1, 1896.

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F 9.

IMPROVEMENT OF FLUSHING BAY, NEW YORK.

Flushing Bay is on the north shore of Long Island, about 14 miles by water from the Battery, New York City. The town of Flushing is on the east bank of Flushing Creek, just above the head of the bay. The bay is about 1 mile wide and 2 miles long. The bottom is of soft mud, nearly level, the depth in the original channel being not much greater than elsewhere. In 1861 a depth of 5 feet at low water was reported in the channel leading up to Flushing. At the beginning of the improvement by the United States the depth there was but 3.9 feet.

The mean rise of tide is 7.1 feet.

PROJECTS FOR IMPROVEMENT.

The first survey of this harbor with a view to its improvement was made in 1878, and a project for improvement was proposed and adopted March 3, 1879, when an appropriation for beginning work was made. The project consisted in diking to form a large tidal basin which should fill and discharge through the channel to maintain a depth of 6 feet at mean low water after that depth had been obtained by dredging. The estimated cost was $173,500. This project was modified in 1888 to omit part of the diking, and in 1891, after 4,663 linear feet of dike had been built on the west side of the channel, to omit the rest and to depend upon dredging alone to maintain the channel. The project of 1879, as thus modified, now consists in building a dike 4,663 feet long on the west side of the channel and in making and maintaining a channel of 6 feet depth at mean low water up to the lower bridge at Flushing, at an estimated cost of $173,500.

Up to July 1, 1896, 4,663 linear feet of diking had been built. The channel, which had been repeatedly dredged, had generally the required depth of 6 feet at mean low water, except at the bend at the south end of the dike, where it was both shoal and narrow.

A sketch of Flushing Bay was printed in the Annual Report of the Chief of Engineers for 1889, page 732.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

Under the appropriation of $4,000, made by the river and harbor act of 1896, after advertising for proposals, a contract was entered into with E. W. Du Bois, of New York City, for dredging about 20,500 cubic yards, removing shoals from and widening the channel; contract dated March 20, 1897, approved by the Chief of Engineers March 25, 1897, expiring July 31, 1897; contract price, 17 cents per cubic yard, measured in scows.

Dredging under this contract was begun April 26 and the contract was completed May 13, 1897, 20,494 cubic yards of material being removed.

Four shoals were removed from the channel. The first, near the deep water off College Point, about 1,000 feet long; the second, 700 feet below the lower or north end of the dike, 250 feet long; the third, at the north end of the dike, 260 feet long; and the fourth, just below the Bridge Street Bridge, 125 feet long.

The depth made was 8 feet below mean low water.

The dredged material was deposited in deep water off Eatons Neck, a distance of 30 miles from Flushing Bay.

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PRESENT CONDITION OF IMPROVEMENT.

The dike, 4,663 feet long, is in poor condition. The outer part, 1,606 feet long, which was left partly completed in 1891, has since been nearly destroyed by storms and ice. Further work upon the dike being discontinued, owing to the strong opposition of property owners along the shores of the bay (see Annual Report of the Chief of Engineers for 1892, p. 723), it is not proposed to repair the structure. A small light at the outer (north) end of the dike, maintained by the Light-House Department, prevents that work in its present condition being a serious menace to local navigation.

The channel up to Flushing has now an available depth of over 6 feet at mean low water. It is in good condition.

PROPOSED OPERATIONS.

Future appropriations will be applied to dredging to maintain and widen the channel to Flushing.

Flushing Bay is in the collection district of New York. The nearest light-house is on North Brother Island, 3 miles to the northwest. There is a small light on the north end of the dike, in the bay, maintained by the Light-House Department. Fort Schuyler and Willetts Point, about 4 miles east from the mouth of the bay, are the nearest works of defense.

Money statement.

July 1, 1896, balance unexpended	$4,477.32
June 30, 1897, amount expended during fiscal year	3,852.08
July 1, 1897, balance unexpended	625.24
Amount (estimated) required for completion of existing project	50,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

Appropriations for improving Flushing Bay, New York, have been made as follows:

Application.	Date.	Amount.
Construction of dike	Mar. 3, 1879	$20,000
Dredging	June 14, 1880	15,000
Do	Mar. 3, 1881	10,000
Do	Aug. 2, 1882	5,000
Do	July 5, 1884	10,000
Do	Aug. 5, 1886	10,000
Construction of dike and dredging	Aug. 11, 1888	15,000
Repair of dike and dredging	Sept. 19, 1890	20,000
Dredging	July 13, 1892	10,000
Do	Aug. 17, 1894	4,000
Do	June 3, 1896	4,000
Total		123,000

Abstract of proposals for dredging in Flushing Bay, New York, opened by Maj. H. M. Adams, Corps of Engineers, New York City, March 12, 1897.

Name and address of bidder.	Rate per cubic yard, scow measurement.	Cubic yards to be removed under price bid.	Remarks.
	Cents.		
Edwin W. Du Bois, New York City	17	20,588	Lowest bid.
J. H. Fenner, Jersey City, N. J.	24	14,583	

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Contract in force during the fiscal year ending June 30, 1897.

Contract for dredging about 20,500 cubic yards, at 17 cents per cubic yard, measured in scows: Name of contractor, Edwin W. Du Bois, of New York City; date of contract, March 20, 1897; date of approval, March 25, 1897; date of beginning work, April 26, 1897; date of expiration, July 31, 1897.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

Arrival and departure of vessels.

Kind of vessel.	Number of round trips.	Draft.	Tonnage.
		Feet.	
Steamers	300	7 to 8	156
Tugs	250		
Sail vessels	130	5 to 16	43 to 575
Barges, etc	204	6 to 12	150 to 530
Total	884	5 to 16	43 to 575

Freight received and shipped by water.

Articles.	Receipts.		Shipments.	
	Tons.	Estimated value.	Tons.	Estimated value.
Coal	33,599	$130,895	.....	.....
Building materials	9,565	44,910	.....	.....
Farm produce	12,000	63,200	.....	.....
Miscellaneous	21,906	1,302,900	.....	.....
General merchandise	.....	.....	3,750	$56,250
Total	77,070	1,541,905	3,750	56,250

The total tonnage of these freights, 80,820 tons, is 48,665 tons less than the amount reported for 1895.

No new lines of freight are reported established since July 1, 1896.

F 10.

IMPROVEMENT OF PATCHOGUE RIVER, NEW YORK.

Patchogue River is a small stream on the south side of Long Island, emptying into Great South Bay near its eastern end, and about 55 miles in a direct line east from New York City. The village of Patchogue, which lies about a mile north of the mouth of the river, has resident population of about 5,000, which is considerably increased during the summer months.

The approach to Patchogue River by water is through Fire Island Inlet, and thence by a rather crooked course for some 14 miles through Great South Bay. The depth through the bay and up to within a half mile of the river's mouth is about 8 feet. At the mouth of the river the natural depth shoaled up to about 2 feet, which depth could be carried up to the village landings.

The mean rise of tide at Patchogue River is 1.1 feet.

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PROJECT FOR IMPROVEMENT.

Under the provisions of the river and harbor act of 1880 a survey of Patchogue River was made, and with the report, printed in the Annual Report of the Chief of Engineers for 1881, page 674, were presented plans and estimates for making a 6-foot channel up the river, at an estimated cost of $42,320. No appropriation was made for carrying out this work.

In 1886 another examination was made, under authority of the river and harbor act of that year. The report on this examination, printed in the Annual Report of the Chief of Engineers for 1887, page 759, presented a project for improvement, which was adopted in 1890, when appropriation was made by Congress for beginning the work. This project consists in dredging to make a channel 60 feet wide and 6 feet deep at mean low water from Great South Bay to the head of navigation, a distance of about 5,000 feet, and in protecting it from westerly storms by a jetty 1,700 feet long, at a total estimated cost of $40,000.

Up to July 1, 1896, the jetty had been built to a length of 1,340 feet, terminating in 4½ feet of water. The dredged channel had been made 3,524 feet long, being within 1,400 feet of the projected limit; the depth was 6 feet at mean low water and the width 60 feet or over.

Harbor lines for Patchogue River were established by the Secretary of War January 17, 1894.

A sketch of Patchogue River was printed in the Annual Report of the Chief of Engineers for 1893, page 984.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

Under the appropriation of $13,000 for completing the project, made by the river and harbor act of 1896, after duly advertising for proposals a contract for dredging about 25,000 cubic yards of material and for completing the jetty was entered into with Kaufman Simon, of New York City; contract dated September 8, 1896, approved by the Chief of Engineers September 12, 1896, and expiring November 30, 1896. The price for dredging was 23 cents per cubic yard, prism measurement, and for repairing and extending the jetty, $2.60 per cubic yard of riprap delivered and placed in the jetty. This contract was extended to April 30, 1897, and subsequently to June 20, 1897.

The contractor began work upon extending and enlarging the jetty in October, 1896, the first stone being placed October 7; this part of the contract was completed December 18, 1896, 2,266.23 cubic yards of stone being placed. The jetty was extended 360 feet, making its total length 1,700 feet, and 425 feet of the previously built work, which had settled, was built up to about 2 feet above high-water mark.

Dredging under this contract was begun May 10, 1897, using a pumping plant and depositing the excavated material upon shore through iron pipes of about 21 inches diameter. Up to the close of the fiscal year the channel of 6 feet depth had been extended to the head of the harbor with width of 60 feet, except at the upper end, where it was made 100 feet to permit vessels being turned about. The contract is not yet completed. The amount removed to June 30, 1897, is about 10,098 cubic yards, prism measurement, approximately, the precise amount to be determined by soundings taken upon completion of work.

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PRESENT CONDITION OF IMPROVEMENT.

The jetty is 1,700 feet long, with the top 3 feet wide and 2 feet above high water level. It is in good condition.

The channel has been made 6 feet deep at mean low water and 60 feet wide or over from Great South Bay to within 80 feet of the harbor lines at the head of the harbor; at the upper part it has been made 40 feet wider to allow of turning vessels around, and parts of the intermediate channel have been widened by private parties.

PROPOSED OPERATIONS.

With the available funds shoals will be removed from the previously dredged channel and the project will be completed.

No further work is proposed.

Patchogue River is in the collection district of New York. The nearest light-house is at Fire Island Inlet, 14 miles southwest. The nearest work of defense is Fort Hale, New Haven Harbor, Connecticut, about 35 miles in a direct line northward.

Money statement.

July 1, 1896, balance unexpended		$14,429.82
June 30, 1897, amount expended during fiscal year		8,471.35
July 1, 1897, balance unexpended		5,958.47
July 1, 1897, outstanding liabilities	$1,963.49	
July 1, 1897, amount covered by uncompleted contracts	3,427.46	
		5,390.95
July 1, 1897, balance available		567.52

Appropriations for improving Patchogue River, New York, have been made as follows:

Application.	Date.	Amount.
Constructing jetty and dredging	Sept. 19, 1890	$15,000
Dredging	July 13, 1892	8,000
Dredging and jetty	Aug. 17, 1894	4,000
	June 3, 1896	13,000
Total		40,000

Abstract of proposals for improving Patchogue River, New York, opened by Maj. H. M. Adams, Corps of Engineers, at New York City, August 24, 1896.

Name and address of bidder.	Dredging (prism measurement).		Jetty, etc.	
	Price per cubic yard.	Amount to be removed under price bid.	Price per ton.	Total bid.
		Cubic yds.		
Joseph Bailey, Patchogue, N. Y.	.....	.....	$2.60	$7,800
Kaufman Simon, New York City	a $0.23	15,217	b 2.60	5,190
S. & E. S. Belden, Hartford, Conn	.....	.....	2.73	8,190
F. S. Whitman, Islip, N. Y.	.36	9,722	.....	.....
A. E. Smith, Islip, N. Y.	.29	12,069	.....	.....

a Lowest bids. b Per cubic yard.

Amounts available: Dredging, $3,500; jetty, etc., $8,000.

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Contract in force during the fiscal year ending June 30, 1897.

Contract: Dredging about 25,000 cubic yards, at 23 cents per cubic yard, prism measurement, and repairing and extending jetty, about 2,000 cubic yards of riprap, at $2.60 per cubic yard, delivered and placed. Name of contractor, Kaufman Simon, of New York City; date of contract, September 8, 1896; date of approval, September 12, 1896; date of beginning work, October 7, 1896; date of expiration, November 30, 1896; extended to April 30, 1897, and subsequently to June 20, 1897.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

Arrivals and departures of vessels.

[Draft 2 to 9* feet, tonnage 8 to 350 tons.]

Kind of vessel.	Number of round trips.	Aggregate tonnage of all trips.
Steamers	1,200	68,500
Sailing vessels	7,200	70,000
Barges	4,200	140,000
Total	12,600	278,500

* Vessels of 9 feet draft can not come into the river without lightering.

Freight received and shipped by water.

Articles.	Tons.	Estimated value.
Received:		
Coal	9,500	$57,000
Lumber	90,000	2,225,000
Miscellaneous	16,000	160,000
Shipped:		
Lumber	16,000	560,000
Fish and shellfish	6,000	170,000
Miscellaneous	6,000	90,000
Total	143,500	3,262,000

Vessels built during 1896, about 40; 2 to 75 tons. Vessels repaired during 1896, about 375; 2 to 300 tons.

The above figures show an increase in freight over the amount reported for 1895 (129,485 tons) of 14,015 tons.

No new lines of transportation are reported as established since July 1, 1896.

F 11.

IMPROVEMENT OF BROWNS CREEK, SAYVILLE, LONG ISLAND, NEW YORK.

Browns Creek is a small stream flowing midway between the villages of Sayville and Bayport, near the south shore of Long Island, and emptying into Great South Bay about 11 miles northeast of Fire Island Inlet. From Fire Island Inlet to the vicinity of Browns Creek there is a rather crooked channel of 8 feet available depth. The original entrance to the creek was crooked, narrow, and shifting. Its depth at mean low water was about 0.4 foot. In the stream itself the mean low water level was from 0.3 to 1.3 feet higher than low water in Great

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South Bay, and the channel depth from zero to 3 feet below low water in the bay. The width of the stream from the bay to the highway bridge, about 5,000 feet, averages 77 feet. Its course lies through a marsh from one-fourth to one-half mile in width, separated from the bay by a low and narrow beach. In its natural condition this stream was not available for any purpose of navigation.

The permanent population of Sayville is said to be 3,500.

The mean rise of tide in Great South Bay is 1.1 feet; at the highway bridge, except in dry seasons, it is scarcely noticeable.

PROJECT FOR IMPROVEMENT.

In pursuance of the river and harbor act of 1888, a survey of Browns Creek was made, the report upon which, printed in the Annual Report of the Chief of Engineers for 1891, page 669, presented a plan for improvement. This was adopted under the river and harbor act of 1890, which made an appropriation for beginning the work. The project consists in securing a harbor where fishing boats can lie in rough weather, by widening and deepening the creek up to the highway bridge, making it 4 feet deep at mean low water and 100 feet wide, with 2 feet greater depth at the entrance, and in protecting the entrance channel by jetties on either side, the west jetty to be 1,600 feet and the east jetty 1,400 feet long. The jetties were designed to be of riprap, the top 3 feet wide and 1 foot above high water. The channel above the mouth of the creek was intended to follow only approximately the crooked course of the natural stream.

Up to July 1, 1896, the west jetty had been built 492 feet long and the east jetty 438 feet. The channel had been made 4 feet deep at mean low water and 100 feet wide for a length of 1,893 feet, beginning at the 4-foot curve in the bay and extending 1,400 feet inside the shore line.

A sketch of Browns Creek was printed in the Annual Report of the Chief of Engineers for 1894, page 710.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

Under the appropriation of $4,000 made by the river and harbor act of 1896, a contract was entered into with Kaufman Simon, of New York City, for dredging about 23,000 cubic yards, prism measurement, at 15 cents per cubic yard; contract dated September 8, 1896, approved by the Chief of Engineers September 12, 1896, and expiring November 30, 1896. Under authority of the Chief of Engineers the contract was extended to April 30, 1897.

Dredging was begun September 29, 1896, and continued until November 2, 1896, when the contractor suspended work on the ground that his plant was not adapted to the conditions; the material dredged during the period amounted to somewhat over 5,000 cubic yards; it was not disposed of in the manner required by the contract, and at the date of suspending work a considerable part had already run back into the channel, therefore no payment for the work was made.

Dredging has not yet been resumed.

PRESENT CONDITION OF IMPROVEMENT.

The west jetty is 492 feet long, and the east jetty 438 feet long, both with top width of 3 feet at 1 foot above high water, and both partly covered at the shore end by accretion. They are in fair condition.

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The dredged channel is 1,893 feet long, with full depth of 4 feet at mean low water, for 100 feet width. About 1,400 linear feet of the channel lies inside the shore line, and is frequently used for night and winter anchorage by small oyster boats. Private canals, aggregating 1,525 feet in length, have been dredged into the marsh on the east side of the canal for additional anchorage and for business purposes.

PROPOSED OPERATIONS.

The available funds and future appropriations will be applied to maintaining and extending the channel and to completing the jetties, as contemplated by the project.

Browns Creek is in the collection district of New York. The nearest light-house is at Fire Island Inlet, about 11 miles southwest. The nearest works of defense are the fortifications at Willets Point, N. Y., about 35 miles west, and Fort Hale, Conn., about the same distance northeastwardly.

Money statement.

July 1, 1896, balance unexpended	$4,287.57
June 30, 1897, amount expended during fiscal year	341.35
July 1, 1897, balance unexpended	3,946.22
July 1, 1897, amount covered by uncompleted contracts	3,390.00
July 1, 1897, balance available	556.22
Amount (estimated) required for completion of existing project	21,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

Appropriations for improving Browns Creek have been made as follows:

Application.	Date.	Amount.
Jetties and dredging	Sept. 19, 1890	$12,000
Dredging	July 13, 1892	5,000
Do	Aug. 17, 1894	4,000
Not yet expended	June 3, 1896	4,000
Total		25,000

Abstract of proposals for dredging in Browns Creek, New York, opened by Maj. H. M. Adams, Corps of Engineers, at New York City, August 24, 1896.

[Amount available, $3,500.]

Name and address of bidder.	Price per cubic yard.	Number of cubic yards to be removed under price bid.
	Cents.	
Kaufman Simon, New York City *a*	*b* 15	23,333
A. E. Smith, Islip, N. Y	*c* 24½	14,286

a Lowest bid. *b* Scow measure. *c* Prism measure.

Contract in force during the fiscal year ending June 30, 1897.

Contract for dredging about 23,000 cubic yards, at 15 cents per cubic yard, prism measurement. Name of contractor, Kaufman Simon, of New York City; date of contract, September 8, 1896; date of approval, September 12, 1896; date of beginning work, September 29, 1896; date of expiration, November 30, 1896; extended to April 30, 1897.

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COMMERCIAL STATISTICS FOR CALENDAR YEAR 1896.

Freight received and shipped by water.

Articles.	Tons.	Estimated value.
Received:		
Brick and coal	1,900	$10,400
Mussels	600	630
Seed oysters	8,666	129,990
Oysters for shipment by rail	700	25,000
	5	500
Shipped:		
Fish for market	70,000	210,000
Oysters carried to New York market by boats using this harbor	5,000	50,000
Clams		
Total	86,871	426,520

These freights were transported in vessels as follows:

Kind of vessel.	Number.	Draft.	Total tonnage.
		Feet.	*Tons.*
Steamers	5	2½ to 3½	48
Sail vessels	270	2 to 5	2,160
Barges, etc	20	2	400
Total	295	2 to 5	2,608

The above figures show an increase in tonnage of freights since 1895 of 50,791 tons. No new lines of transportation have been established since July 1, 1896.

F 12.

IMPROVEMENT OF CANARSIE BAY, NEW YORK.

Canarsie Bay is the northwest part of Jamaica Bay, at and in front of Canarsie Landing. Jamaica Bay is about 6 miles east and west by 4 miles north and south, connecting with the Atlantic Ocean through Rockaway Inlet, in the south shore of Long Island, 7 miles east from The Narrows at the entrance to New York Harbor. Jamaica Bay contains a number of scattered marshy islands separated by channels of different depths. One of these channels, called "Big Channel," carries a depth of 12 feet at mean low water up to within three-fourth of a mile of Canarsie Landing. From this channel to the landing the course was over flats with about 4½ feet available depth at low tide.

The mean rise of tide is 4.7 feet.

PROJECTS FOR IMPROVEMENT.

The river and harbor act of 1878 directed that a survey of Canarsie Bay be made. It was made the same year and the report upon it, dated February 11, 1879, is printed in the Annual Report of the Chief of Engineers for 1879, page 400. The plan of improvement proposed in this report was for diking to form a tidal basin which should fill and empty within a limited width and maintain a navigable channel between Canarsie Landing and deep water in "Big Channel." The depth and width which these works were designed to maintain was not stated. The estimated cost of the diking for the tidal basin and channel was $88,000;

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the dikes to be built of a double row of piles filled in with stone, and the timber work to be creosoted.

In 1882, after $10,000 had been expended on diking, it was reported that the conditions seemed favorable for maintenance of a dredged channel without another dike, and in 1883 and subsequently the construction of a tidal basin was abandoned, and the depth of channel to be obtained by dredging was fixed at 6 feet below mean low water.

In 1889 the project was extended to include dredging a 4-foot channel from Town Dock, Canarsie Landing, to "Island Channel," a distance of about one-fourth of a mile. This channel was designed to divert part of the tidal current, which crossed the main Canarsie Channel nearly at right angles, as well as to accommodate a limited commerce which might use that route.

No change has been made in the estimate of cost. The funds originally designed for diking will be needed for dredging to maintain the channel.

The existing project for this improvement is therefore to make a channel from deep water in Jamaica Bay to Canarsie Landing, to be 6 feet deep at mean low water and from 100 to 150 feet wide, and to protect it by two parallel pile dikes near its outer end; also to make a channel 4 feet deep, connecting Canarsie Landing at Town Dock with Island Channel. The estimated cost is $88,000.

Up to July 1, 1896, two pile dikes had been built and maintained on the north and south sides of the channel at its entrance into "Big Channel," of lengths respectively of 1,058 and 820 feet. The east channel from Canarsie landing had been dredged 100 to 150 feet wide and 6 feet deep, and the cut to connect with Island Channel had been made 4 feet deep, with width from 20 to 70 feet.

A sketch of Canarsie Bay was printed in the Annual Report of the Chief of Engineers for 1882, page 670.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

Under the appropriation made by the river and harbor act of 1896, with a balance from a previous appropriation, a contract was entered into with Elijah Brainard, of New York City, for dredging about 35,000 cubic yards of material, at 28 cents per cubic yard; contract dated September 8, 1896, approved by the Chief of Engineers September 22, 1896, and expiring January 10, 1897; subsequently extended to April 1, 1897. Dredging under this contract was begun September 28, 1896, and completed January 21, 1897, 35,714 cubic yards of material being removed and deposited in deep water 2½ miles south of Coney Island. The channel from Canarsie Dock to "Big Channel," Jamaica Bay, was deepened by removing shoals, and restored to its full depth of 6 feet at mean low water, with widths from 125 to 150 feet for its entire length, 4,200 feet; and a channel was dredged to connect the Canarsie Channel with the Gophel Channel to the northeast, 2,200 feet long, 50 feet wide, and 5 feet deep at mean low water.

PRESENT CONDITION OF IMPROVEMENT.

The two pile dikes built at the east entrance of the main channel to Canarsie Landing are in fair condition. The north dike is 1,058 feet long, 50 feet being a return at the east end; it is mainly of creosoted timber. The channel face, for a linear distance of 20 feet near the outer end, has been broken down by the ice and the stone filling

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released. The south dike is 820 feet long; it is not creosoted and many of the piles are worm-eaten.

The stone filling in both dikes has settled slightly.

The dredged channel from Canarsie Landing to "Big Channel," in Jamaica Bay, is 125 to 150 feet wide with full depth of 6 feet at mean low water; the channel from the landing southwestwardly to "Island Channel," dredged 4 feet deep, has shoaled a foot or more. The channel connecting with the "Gophel Channel" is 5 feet deep and about 50 feet wide.

PROPOSED OPERATIONS.

Future appropriations will be applied to keeping the dikes in repair and to maintaining and widening the dredged channels. Except for widening the dredged channels in places, the project for improvement is completed.

Canarsie Bay is in the collection district of New York. The nearest light-house is on the west end of Coney Island, about 7 miles to the southwest. The nearest work of defense is Fort Hamilton, New York Harbor.

Money statement.

July 1, 1896, balance unexpended	$11,804.89
June 30, 1897, amount expended during fiscal year	11,275.48
July 1, 1897, balance unexpended	529.41
Amount (estimated) required for completion of existing project	23,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

Appropriations for improving Canarsie Bay, New York, have been made as follows:

Application.	Date.	Amount.
Constructing north dike, about 1,900 feet	June 14, 1880	$10,000
Dredging east channel, repairing north dike with crib at east end	Mar. 3, 1881	5,000
	Aug. 2, 1882	3,000
Dredging east channel, extending north dike 50 feet	July 5, 1884	5,000
Dredging east channel, building south dike 820 feet	Aug. 5, 1886	10,000
Dredging east and southwest channels	Aug. 11, 1888	10,000
Dredging east channel, repairs north dike	Sept. 19, 1890	5,000
Dredging east and southwest channels	July 13, 1892	5,000
Repairs of dike, dredging	Aug. 17, 1894	2,000
Dredging	June 3, 1896	10,000
Total		65,000

Abstract of proposals for dredging in Canarsie Bay, New York, opened by Maj. H. M. Adams, Corps of Engineers, New York City, August 24, 1896.

[Amount available, $10,000.]

Name and address of bidder.	Price per cubic yard, scow measurement.	Number of cubic yards to be removed under price bid.
	Cents.	
Elijah Brainard, New York City *a*	28	35,714
A. E. Smith, Islip, N. Y.	27½	36,364

a Recommended for acceptance.

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Contract in force during the fiscal year ending June 30, 1897.

Contract: Dredging about 35,000 cubic yards, at 28 cents per cubic yard, measured in scows. Name of contractor, Elijah Brainard, of New York City; date of contract, September 8, 1896; date of approval, September 22, 1896; date of beginning work, September 28, 1896; date of expiration, January 10, 1897, extended to April 1, 1897.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

Articles received and shipped by water.	Tons.	Estimated value.
Fish and shellfish	29,837	$360,000
Coal	15,250	53,375
Building materials	5,000	14,000
Total	50,087	427,375

Kind of vessel.	Number.	Average draft.	Average tonnage.
		Feet.	*Tons.*
Steam	15	5½	30
Sail	110	5½	18
Barges	10	4	150
Yachts	185	3½	4
Total	320	.....	.....

The above figures show a decrease in the amount of commerce of 98,477 tons under that reported for 1895, due chiefly to the omission of shipments from Barren Island, which were included heretofore in the statistics pertaining to Canarsie Bay.

A new line of transportation was opened to Bergen Beach in 1896.

The principal use of the channels in Canarsie Bay was for the transportation of about 750,000 passengers to and from the summer resorts on Rockaway Beach, Bergen Beach, and Ruffle Bar.

F 13.

IMPROVEMENT OF BAY RIDGE CHANNEL, THE TRIANGULAR AREA BETWEEN BAY RIDGE AND RED HOOK CHANNELS, AND RED HOOK AND BUTTERMILK CHANNELS, IN THE HARBOR OF NEW YORK.

The main channel from the Narrows to the East River, New York Harbor, passes to the west and northwest of Governors Island. It has natural depths of 35 feet or over and generally an ample width. There is an eastern channel which skirts the Brooklyn water front, extending northwardly from Bay Ridge, crossing Gowanus Bay, rounding Red Hook, and thence by way of Buttermilk Channel connecting with the East River. The lower part of this channel from Bay Ridge to Erie Basin had natural depths of from 7 to 12 feet. Opposite Gowanus Bay it was separated from the main channel of the harbor by a large shoal of about 9 feet depth; the upper part had a depth of 26 feet in a channel 300 feet wide or more, but crooked, and on account of the rapid current and the large amount of traffic in and near its junction with the East River it was formerly regarded as one of the most difficult places to navigate in New York waters. The line of docks along the water front of this east channel, and especially in the upper part, from the Brooklyn Bridge to Red Hook, is one of the most important in New York Harbor.

PROJECTS FOR IMPROVEMENT.

Prior to 1896 this improvement was carried on under two separate titles: Improvement of Buttermilk Channel, New York Harbor, which included the removal of Buttermilk and Red Hook shoals, and improve-

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ment of Gowanus Bay, New York Harbor, which included Bay Ridge and Red Hook channels and the triangular area between them, and also Gowanus Creek Channel.

In 1872 a survey of Buttermilk Channel was made, and under the river and harbor act of 1880 a project was adopted for removing the eastern part of the north shoal, called Buttermilk Shoal, to a depth of 26 feet at mean low water. The project was subsequently extended to include the removal of the entire shoal, which was accomplished July 3, 1891, at a total cost of $321,000; the amount dredged from this shoal was 1,269,484 cubic yards. In 1890 a preliminary examination of Buttermilk Channel was made, and under the river and harbor act of 1892 a project was adopted for removing the south shoal, Red Hook shoal, to a depth of 26 feet below mean low water, estimated to require the removal of 1,484,048 cubic yards of sand and small bowlders overlying clay, at a total cost of $529,000, of which $25,000 from previous appropriations remained available. This plan did not contemplate dredging nearer to the dock line than 50 feet, thus widening the natural channel by about 1,000 feet.

Up to July 1, 1896, under this project, 519,954 cubic yards had been dredged from Red Hook Shoal, cutting off the outer end of the shoal and widening the 26-foot channel by 600 feet.

A survey of Gowanus Bay was made in 1880, and under the river and harbor act of 1880 a project for improvement was adopted which, as modified by the river and harbor acts of 1890 and 1894, consisted in dredging Red Hook Channel (from Erie Basin entrance to the foot of Henry street) to a width of 400 feet and depth of 26 feet at mean low water; Gowanus Creek Channel (from Henry street to Percival street) to a width of 250 feet and depth of 21 feet; Gowanus Canal (from Percival street to the Hamilton Avenue Bridge) to a width of 200 feet and depth of 18 feet; Bay Ridge Channel (from Henry street and Twenty-eighth street to the 26-foot curve opposite Bay Ridge) to a width of 800 feet and depth of 26 feet; and the triangular area between Bay Ridge and Red Hook channels to a maximum width of 900 feet and depth of 26 feet. The total estimated cost of this work was $1,124,400. Under this project, up to July 1, 1896, Red Hook Channel had been made 200 feet wide and 26 feet deep, an additional 150 feet of width being made 21 feet deep; Gowanus Creek had been made 21 feet deep between the harbor lines; Gowanus Canal had been made 12 feet deep; Bay Ridge Channel had been made 175 to 200 feet wide and 26 feet deep, and an additional width of 175 to 200 feet had been made 21 feet deep. No work had been done upon the triangular area.

By the terms of the river and harbor act of 1896 the Bay Ridge and Red Hook channels, the triangular area between them, and the Buttermilk Channel were consolidated into one improvement, together with a small improvement of Gowanus Canal, and the project for this work now consists in dredging channels of 26 feet depth at mean low water, with widths as follows: For Bay Ridge Channel, 800 feet; for the triangular area between Bay Ridge and Red Hook channels, maximum width 900 feet; for the Red Hook Channel, 400 feet; for Buttermilk Channel, at Red Hook Shoal, 1,000 feet, and for dredging Gowanus Canal from Percival street to Hamilton Avenue Bridge to the extent of $5,000, at a total estimated cost of $837,000.

Harbor lines in Gowanus Bay and Buttermilk Channel were established by the Secretary of War March 4, 1890. These harbor lines in the Gowanus Creek Channel were slightly modified by act of Congress passed June 3, 1896.

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OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

Under the terms of the river and harbor act of June 3, 1896, which appropriated $200,000 for this work, authorized the making of contract for completion of the project at not to exceed the estimated cost, and provided that $5,000 of the appropriation then made should be applied to dredging in Gowanus Canal, after due advertisement a contract for this work was entered into with the W. H. Beard Dredging Company, under date of October 6, 1896, approved by the Chief of Engineers October 15, 1896. This contract provides for dredging in Bay Ridge Channel, in the triangular area between Bay Ridge and Red Hook channels, in Red Hook Channel, and in Gowanus Canal, an amount estimated at 3,000,000 cubic yards, more or less, at the rate of 14 cents per cubic yard, measured in scows; also for dredging on Red Hook Shoal, estimated at 1,000,000 cubic yards, more or less, at the rate of 21 cents per cubic yard, measured in scows. It further provides that whenever funds are available for work the engineer officer shall notify the contractor in writing, shall indicate the work to be done, and assign a reasonable date for completion thereof, but not such as to require the removal of more than 150,000 cubic yards of dredged material per month. In accordance therewith the contractors were notified October 16, 1896, immediately after approval of the contract, that the amount of work to be done with the funds then available would be about 1,170,000 cubic yards, and that it must be completed by June 30, 1897.

Dredging under this contract was begun October 20, 1896, and up to June 30, 1897, 872,617 cubic yards of material had been dredged—33,011 cubic yards were removed from Gowanus Canal, making the channel 18 feet deep at mean low water, with widths of 55 to 155 feet, from Percival street to a point 50 feet below the Hamilton Avenue Bridge; the rest, 839,606 cubic yards, was removed from Bay Ridge Channel.

Below Forty-third street, Brooklyn, the channel was widened by about 600 feet, making it 800 feet wide; above Forty-third street it was widened by 70 to 100 feet, making it 270 feet wide, with a full depth of 26 feet at mean low water; above Forty-third street an additional width of from 200 to 400 feet has been dredged about 15 feet deep, as a preliminary to making the full required depth.

By act of Congress of June 4, 1897, $350,000 was appropriated for continuing this work. The contractors were accordingly notified June 18, 1897, that the amount of the work to be done with these additional funds was about 2,150,000 cubic yards, and that the date assigned for its completion was October 31, 1898.

The prices for work under the contract are somewhat lower than the original estimates, and the entire work contemplated under the contract and the project can be completed for $680,000.

PRESENT CONDITION OF IMPROVEMENT.

Bay Ridge Channel has been made 26 feet deep at mean low water and 800 feet wide from the 26-foot curve opposite the Bay Ridge docks up to Forty-third street, Brooklyn, a distance of about 5,000 feet; above this point it has been made 270 feet wide. The triangular area between Bay Ridge and Red Hook channels has not been dredged.

Red Hook Channel has been made 26 feet deep and 200 feet wide, an additional width of 150 feet having been made 21 feet deep.

Buttermilk Channel has been made the full depth and width at the upper end; at the lower end 600 feet width has been dredged from the channel side of Red Hook Shoal.

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PROPOSED OPERATIONS.

Under the contract now in force, and with such appropriations as may be made from time to time, the project will be completed.

These channels are in the collection district of New York, of which New York City is the port of entry. The nearest light-house is the Statue of Liberty Enlightening the World, on Bedloes Island, about 1½ miles west. The nearest work of defense is Fort Columbus, Governors Island, New York.

Money statements.

BAY RIDGE CHANNEL, THE TRIANGULAR AREA BETWEEN BAY RIDGE AND RED HOOK CHANNELS, AND RED HOOK AND BUTTERMILK CHANNELS.

July 1, 1896, balance unexpended		$200,000.00
Amount appropriated by sundry civil act approved June 4, 1897		350,000.00
		550,000.00
June 30, 1897, amount expended during fiscal year		94,439.69
July 1, 1897, balance unexpended		455,560.31
July 1, 1897, outstanding liabilities	$33,622.71	
July 1, 1897, amount covered by uncompleted contracts	376,255.16	
		409,877.87
July 1, 1897, balance available		45,682.44
Amount (estimated) required for completion of existing project		130,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899		130,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

CHANNEL IN GOWANUS BAY, NEW YORK.

July 1, 1896, balance unexpended	$1,160.86
June 30, 1897, amount expended during fiscal year	101.86
July 1, 1897, balance unexpended	1,059.00

BUTTERMILK CHANNEL, NEW YORK.

July 1, 1896, balance unexpended	$2,699.82
June 30, 1897, amount expended during fiscal year	312.50
July 1, 1897, balance unexpended	2,387.32

Appropriations for improving Bay Ridge and Red Hook channels, and the triangular area between them, and Buttermilk Channel, New York Harbor, have been made as follows:

For previous projects.

Application.	Date.	Amount.	
		Buttermilk Channel, including Buttermilk and Red Hook shoals.	Bay Ridge, Red Hook, and Gowanus Creek channels.
Dredging	June 14, 1880	$60,000	.....
Do	Mar. 4, 1881	60,000	$40,000
Do	Aug. 2, 1882	60,000	20,000
Do	July 5, 1884	10,000	5,000
Do	Aug. 5, 1886	56,250	7,500
Do	Aug. 11, 1888	100,000	60,000
Do	Sept. 19, 1890	.....	160,000
Do	July 13, 1892	100,000	198,600
Do	Aug. 17, 1894	50,000	150,000
Total	.....	496,250	641,100
Received from other sources	.....	100	.....
Total	.....	496,350	641,100

Total for previous projects, including dredging in Gowanus Canal, $1,137,450.

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For present projects.

Application.	Date.	Amount.
Dredging	June 3, 1896	$200,000
Do	June 4, 1897	350,000
Total		550,000

Abstract of proposals for dredging in Bay Ridge Channel, the triangular area between Bay Ridge and Red Hook channels, in Red Hook and Buttermilk channels, and in Gowanus Canal, New York, opened by Maj. H. M. Adams, Corps of Engineers, at New York City, September 25, 1896.

[Amount available, $170,000.]

No.	Name and address of bidders.	Dredging in Bay Ridge Channel, in triangular area between Bay Ridge and Red Hook channels, in Red Hook Channel and in Gowanus Canal (3,000,000 cubic yards).		Dredging on the Red Hook Shoal, Buttermilk Channel (1,000,000 cubic yards).		Total for entire work.
		Price per cubic yard.	Total bid.	Price per cubic yard.	Total bid.	
1	The W. H. Beard Dredging Co., New York City *a*	*Cents.* 14	$420,000	*Cents.* 21	$210,000	$630,000
2	Virginia Dredging Co., Richmond, Va	21	630,000	24	240,000	870,000
3	Rittenhouse R. Moore, Mobile, Ala	16	480,000	22	220,000	700,000

a Lowest bid; recommended for acceptance.

Contract in force during the fiscal year ending June 30, 1897.

Contract for dredging about 3,000,000 cubic yards from Bay Ridge Channel, the triangular area between Bay Ridge and Red Hook channels, from Red Hook Channel and Gowanus Canal, at 14 cents per cubic yard, measured in scows, and about 1,000,000 cubic yards from Red Hook Shoal, Buttermilk Channel, at 21 cents per cubic yard, measured in scows. Name of contractor, The W. H. Beard Dredging Co., New York City; date of contract, October 6, 1896; date of approval, October 15, 1896; date of beginning work, October 20, 1896; expiration of contract, indefinite; the contract provides for completion of the project whenever appropriations are made for the purpose.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

Freight received and shipped.

	Amount.	Estimated value.
Bay Ridge Channel (Sixty-ninth to Twenty-eighth street):	*Tons.*	
Receipts	627,200	$8,696,170
Shipments	90,799	3,349,100
Red Hook Channel (Henry street to mouth of Erie Basin):		
Receipts	418,172	1,674,336
Shipments	415,184	1,660,736
Buttermilk Channel (Erie Basin to Atlantic avenue):		
Receipts	6,884,668	137,693,360
Shipments	8,195,650	164,913,000
Total	16,631,673	317,986,702

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Vessels, not including tugs or ferryboats.

	Number.	Draft.
Bay Ridge Channel (Sixty-ninth to Twenty-eighth street):		*Feet.*
Steam	263	6 to 22
Sail	684	8 to 20
Barges	3,144	4 to 12
Red Hook Channel (Henry street to mouth of Erie Basin):		
Steam	700	12 to 20
Sail	30	10 to 20
Barges	2,263	6 to 10
Rafts	175	.....
Buttermilk Channel (Erie Basin to Atlantic avenue):		
Steam	1,817	18 to 28
Sail	217	18 to 28
Barges, etc	68,096	.....
Total	77,389	4 to 28

The above includes only freight received and shipped at the docks, except in case of Red Hook Channel, where the freight consists principally of coal in barges which are brought to this channel, assembled in tows and taken away.

In addition to the above, 2,164,654 tons of freight were reported as passing through these channels into Gowanus Creek and Gowanus Canal, carried in 12,309 vessels of 4 to 24 feet draft.

F 14.

IMPROVEMENT OF GOWANUS CREEK CHANNEL, NEW YORK.

Gowanus Creek was originally a tidal inlet in the southern part of the city of Brooklyn, emptying into Gowanus Bay. This creek has been improved by the United States as part of the improvement of Gowanus Bay, and for the purpose of the improvement the Gowanus Creek Channel has been defined as extending from the junction of the Bay Ridge and Red Hook channels, opposite Henry street, Brooklyn, and Twenty-eighth street, South Brooklyn, eastwardly to the foot of Percival street, that part of the creek east of Percival street being called Gowanus Canal.

In 1880, before improvement by the United States, Gowanus Creek Channel had an available depth of about 11 feet at mean low water.

PROJECTS FOR IMPROVEMENT.

A survey of Gowanus Creek and Bay was made in 1880, and in 1881 a project for improvement was adopted providing for a channel in Gowanus Creek 18 feet deep at mean low water and 200 feet wide, which, with the Gowanus Bay channels, was estimated to cost $182,500. After the depth had been made, under the terms of the river and harbor act of 1888, the project was extended to provide for a depth of 21 feet at mean low water. This depth was made between the harbor lines on either side of the creek, under the river and harbor act of 1892, and the project was completed. At the time of completion of the project $491,100 had been appropriated for and expended upon the several channels in Gowanus Bay. It is estimated that about $75,000 of this sum was applied to the Gowanus Creek Channel.

Under the river and harbor act of 1896, appropriating $25,000 for improving Gowanus Creek Channel, New York, by deepening the same

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to 26 feet at mean low water from the foot of Percival street to its junction with the Red Hook Channel, a project was adopted for making Gowanus Creek Channel 26 feet deep at mean low water, at an estimated cost of $70,000.

Harbor lines for part of New York Harbor, including the Gowanus Creek Channel, were established by the Secretary of War March 4, 1890.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

The river and harbor act of 1896 appropriated $25,000 for deepening this channel to 26 feet at mean low water, and after advertising for proposals a contract was entered into with Henry S. Beard, of New York City, for dredging about 91,600 cubic yards of material at 24 cents per cubic yard for sand, etc., and at $12 per cubic yard for bowlders of one-half cubic yard or over; contract dated March 20, 1897, approved by the Chief of Engineers March 25, 1897, and expiring September 30, 1897. Dredging under this contract was begun April 5, 1897, at its junction with the Red Hook Channel, and up to the close of the fiscal year 75,417 cubic yards had been dredged, making a 26-foot channel throughout the length of Gowanus Creek about 100 feet wide. Work is still in progress.

The material dredged has been hard sand, in some cases compacted with clay; no bowlders have been encountered.

PRESENT CONDITION OF IMPROVEMENT.

Under previous projects Gowanus Creek has been dredged to 21 feet depth at mean low water between the harbor lines on either side. Under the present project the channel has been made 26 feet deep for its full length, with width of about 100 feet.

PROPOSED OPERATIONS.

Under the contract now in force the channel will be made 26 feet deep at mean low water, with about 120 feet width.

Future appropriations will be applied to widening the channel as proposed in the project.

Gowanus Creek is in the collection district of New York. The nearest light-house is the Statue of Liberty Enlightening the World, on Bedloes Island, New York Harbor. The nearest work of defense is Fort Columbus, Governors Island, New York.

Money statement.

July 1, 1896, balance unexpended		$25,000.00
June 30, 1897, amount expended during fiscal year		11,129.50
July 1, 1897, balance unexpended		13,870.50
July 1, 1897, outstanding liabilities	$7,867.00	
July 1, 1897, amount covered by uncompleted contracts	3,899.20	
		11,766.20
July 1, 1897, balance available		2,104.30
Amount (estimated) required for completion of existing project		45,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1899		25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

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Appropriations for Gowanus Creek Channel, New York, have been made as follows:

Application.	Date.	Amount.
For previous projects:		
Parts of the appropriations for Gowanus Bay channels, applied to Gowanus Creek, estimated to amount to about $75,000; dredging to 21 feet depth.	Mar. 3, 1881, to July 13, 1892.	$75,000
For the present project:		
Dredging 26 feet deep	June 3, 1896	25,000
Total		100,000

Abstract of proposals for dredging in Gowanus Creek, New York, opened by Maj. H. M. Adams, Corps of Engineers, at New York City, March 12, 1897.

[Amount available, $22,000.]

No.	Name and address of bidder.	Rate per cubic yard (scow measurement).	Number of cubic yards under price bid.
		Cents.	
1	Henry S. Beard, New York City *a*	24	91,667
2	Elijah Brainard, New York City	29	75,862

a Lowest bid.

Contract in force during the fiscal year ending June 30, 1897.

Contract for dredging about 91,600 cubic yards, at 24 cents per cubic yard for sand, etc., and $12 per cubic yard for bowlders of one-half cubic yard or over. Name of contractor, Henry S. Beard, of New York City; date of contract, March 20, 1897; date of approval, March 25, 1897; date of beginning work, April 5, 1897; date of expiration, September 30, 1897.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

Cargoes.

	Tons.	Estimated value.
Receipts	167,488	$1,384,381
Shipments	53,260	1,018,634
Total	220,748	2,403,015

Vessels.

Kind.	Number.	Draft.
		Feet.
Steam	982	8 to 21
Sail	911	8 to 24
Barges, etc.	1,163	4 to 12
Rafts	14	.....
Total	3,070	4 to 24

The above refers to freight unloaded along Gowanus Creek. In addition to this there was transported through the creek to or from Gowanus Canal 1,943,906 tons of freight, carried in 9,239 vessels of 4 to 12 feet draft, being the limit of available draft in Gowanus Canal in 1896.

No new lines of transportation are reported as established since July 1, 1896.

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F 15.

IMPROVEMENT OF NEWTOWN CREEK, NEW YORK.

Newtown Creek is a tidal stream about 4 miles long, extending through the eastern and northern part of the city of Brooklyn and emptying into the East River opposite Thirty-fourth street, New York City. In 1857 it was reported to have a depth of about 17 feet at the entrance. In 1880 the channel from the entrance to Vernon Avenue Bridge, a distance of about 2,300 feet, was 12½ feet deep at mean low water for a width of 100 feet or over. The depth and width of the stream gradually decreased to the Metropolitan Avenue bridges, where the low-water depth was about 4 feet.

The mean rise of tide at Newtown Creek is about 4½ feet.

PROJECTS FOR IMPROVEMENT.

In compliance with the terms of the river and harbor act of 1879 a survey of Newtown Creek was made, and in 1881 a project for deepening the channel to the Vernon Avenue Bridge (2,300 feet) was adopted. Under the river and harbor acts of 1882 and 1884 a new survey was made and the project extended to include dredging up to the Metropolitan Avenue bridges across both branches of the creek, the proposed depths decreasing from 21 feet at the entrance to 10 feet at the upper bridges and the widths decreasing from 200 to 100 feet.

Under the terms of the river and harbor act of 1896 the project was modified to provide for a uniform channel 125 feet wide and 18 feet deep at mean low water to the Metropolitan Avenue bridges, at an estimated cost of $450,000. Thirty thousand dollars was appropriated for beginning the work, and the Secretary of War was authorized to enter into contract for completion of the project.

Up to July 1, 1896, no work had been done under the modified project. Under the previous projects a channel 18 feet deep and from 40 to 175 feet wide had been made for about 10,000 feet up the creek from the mouth, and for the rest of the distance to the Metropolitan Avenue bridges it had been made 10 to 14 feet deep and 50 to 100 feet wide.

A detailed description of work done under the previous projects was printed in the Annual Report of the Chief of Engineers for 1896, pages 760–761.

Harbor lines for Newtown Creek from the mouth to Dutch Kills and Whale Creek were established by the Secretary of War February 8, 1890, and they were extended to Metropolitan avenue by the Secretary of War December 29, 1890.

A sketch of Newtown Creek was printed in the Annual Report of the Chief of Engineers for 1885, page 658.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

Under the provisions of the river and harbor act of 1896, after advertising for proposals, a contract for completion of the work contemplated in the modified project was entered into with John H. Fenner, of Jersey City, N. J., under date of October 20, 1896, and approved by the Chief of Engineers October 31, 1896. This contract provides for excavation of all material except bowlders of one-half cubic yard or over, estimated to amount to about 965,000 cubic yards, at the rate of 17⅜ cents per cubic yard, and for the removal of bowlders of one-half cubic yard or over,

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estimated to amount to about 3,200 cubic yards, at the rate of $8 per cubic yard. It further provides that whenever funds are available for work the engineer officer shall notify the contractor in writing; shall indicate the work to be done, and assign a reasonable date for completion thereof, but not such as to require the removal of more than 60,000 cubic yards of dredged material, or the equivalent, per month. In accordance therewith, the contractor was notified November 2, 1896, immediately after approval of the contract, that the amount of work to be done with the available funds would be about 115,000 cubic yards, and that it must be completed on or before February 28, 1897.

Dredging under the contract was begun November 12, 1896, and the amount of work required was done May 24, 1897, the expenses for inspection and superintendence from February 28 to that date being deducted from payments to the contractor, as provided by the contract. When the work required was completed, the contractor elected to continue work under the provisions of the contract, payment to be made when sufficient funds became available.

The total amount of work done under this contract during the fiscal year was the removal of 136,158 cubic yards of dredged material and 98.35 cubic yards of bowlders of one-half cubic yard or greater. The channel from 150 feet above Vernon Avenue Bridge to 2,735 feet above Greenpoint Avenue Bridge (a distance of 7,500 feet) was made 125 feet wide and 18 feet deep at mean low water, except within 50 to 75 feet from the Greenpoint Avenue Bridge, where dredging was deferred to allow the local authorities opportunity to strengthen the bridge piers so that they would not be endangered by the dredging.

The prices under the contract were much lower than the prices estimated for doing this work, and the entire project can be completed, at the contract rates, for $213,000.

By act of Congress of June 4, 1897, $183,000 was appropriated for completing the projected improvement. The contractor was accordingly notified, June 18, 1897, that the amount of dredging to be done with the available funds was about 850,000 cubic yards, and the date assigned for completion of the work was October 31, 1898.

PRESENT CONDITION OF IMPROVEMENT.

There is now a depth of 18 feet at mean low water, with width of 125 feet from the mouth of the creek to 2,735 feet above Greenpoint Avenue Bridge, a distance of about 2 miles, except in and close to the draws of the Vernon Avenue and Greenpoint Avenue bridges, where work was delayed to admit of rebuilding or protecting the bridge piers. Above this point, to the Metropolitan Avenue bridges, the channel dredged to 10 feet depth has shoaled so that the available depth is about 8 feet at mean low water.

PROPOSED OPERATIONS.

Under the contract now in force, and with the funds already appropriated, the project for a channel 125 feet wide and 18 feet deep will be completed.

Newtown Creek is in the collection district of New York, of which New York City is the port of entry. The nearest light-house is on Blackwells Island, New York Harbor. The nearest work of defense is Fort Columbus, Governors Island, New York Harbor.

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Money statement.

July 1, 1896, balance unexpended		$30,000.00
Amount appropriated by sundry civil act approved June 4, 1897		183,000.00
		213,000.00
June 30, 1897, amount expended during fiscal year		20,953.67
July 1, 1897, balance unexpended		192,046.33
July 1, 1897, outstanding liabilities	$6,136.29	
July 1, 1897, amount covered by uncompleted contracts	167,878.26	
		174,014.55
July 1, 1897, balance available		18,031.78

Appropriations for Newtown Creek have been made as follows:

Application.	Date.	Amount.
Dredging below Vernon avenue	June 14, 1880	$10,000
Do	Aug. 2, 1882	15,000
Dredging entrance to Metropolitan avenue	July 5, 1884	20,000
Do	Aug. 5, 1886	37,500
Do	Aug. 11, 1888	25,000
Dredging entrance to Metropolitan avenue and English Kills	Sept. 19, 1890	35,000
Dredging entrance to Metropolitan avenue	July 13, 1892	35,000
Do	Aug. 17, 1894	20,000
Dredging	June 3, 1896	30,000
Dredging (not yet expended)	June 4, 1897	183,000
Total		410,500

Abstract of proposals for dredging in Newtown Creek, New York, opened by Maj. H. M. Adams, Corps of Engineers, at New York City, September 25, 1896.

[Amount available, $20,000.]

No.	Name and address of bidder.	Dredging (965,000 cubic yards).		Removing bowlders (3,200 cubic yards).		Total for entire work.
		Per cubic yard.	Price bid.	Per cubic yard.	Price bid.	
		Cents.				
1	J. H. Fenner, Jersey City, N. J. *a*	17⅞	$167,668.75	$8.00	$25,600	$193,268.75
2	Virginia Dredging Co., Richmond, Va	27	260,550.00	6.95	22,240	282,790.00
3	Eugene Breymann and John B. Breymann, Toledo, Ohio	22				*b*213,004.00
4	The International Contracting Co., Syracuse, N. Y	22 9/16	220,985.00	3.75	12,000	232,985.00
5	Morris & Cummings Dredging Co., New York City	29½	284,675.00	4.00	12,800	297,475.00

a Lowest bid.

b Price includes bowlders.

Contract in force during the fiscal year ending June 30, 1897.

Dredging about 965,000 cubic yards of material, at 17⅞ cents per cubic yard, and removing bowlders of one-half cubic yard capacity or over, at $8 per cubic yard. Name of contractor, John H. Fenner, of Jersey City, N. J.; date of contract, October 20, 1896; date of approval, October 31, 1896; date of beginning work, November 12, 1896; expiration of contract, indefinite. The contract provides for completion of the project whenever appropriations are made for the purpose.

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COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

Freights received and shipped by water.

Articles.	Receipts.		Shipments.	
	Tons.	Value.	Tons.	Value.
Coal	644,935	$2,281,024	.....	.....
Lumber	269,208	2,812,782	23,200	$490,000
Building materials	393,645	2,056,850	.....	.....
Petroleum products	330,903	4,149,693	525,259	10,170,018
Chemicals	45,314	1,371,301	70,589	2,402,703
Miscellaneous	326,210	6,752,916	111,219	7,171,477
Total	2,010,215	19,424,566	730,267	20,234,198

The above freight was carried by vessels as follows:

Kind of vessel.	Number.	Draft.	Tonnage.
		Feet.	*Tons.*
Steamers	708	5 to 16	75 to 1,000
Sailing vessels	1,625	6 to 19	90 to 2,300
Barges, etc	12,180	3 to 12	40 to 600
Total	14,513	.....	.....

The above figures show a total tonnage, receipts and shipments, of 2,740,482 tons, being 11,796 tons less than reported for the year 1895.

No new lines of transportation have been reported established since July 1, 1896.

F 16.

IMPROVEMENT OF PASSAIC RIVER, NEW JERSEY.

The Passaic River is a stream of considerable size, rising in the highlands in the northern part of New Jersey and flowing in a general easterly and southerly course into Newark Bay, through which and the Kill van Kull it connects with the upper bay of New York Harbor. Navigation is confined to the tidal part of the river, which extends to the city of Passaic, about 13¼ miles above the head of Newark Bay and about 15¾ miles by course of channel above the lowest obstructive shoal in the bay. At Passaic there is a dam furnishing water power. Attempts have been made by a private corporation to extend navigation to the city of Paterson, about 9 miles above Passaic, by means of locks and dams, but the enterprise has never been completed.

From the turnpike bridge at Passaic to Newark Bay the river is crossed by eight railroad bridges and five turnpike bridges, all provided with draws. The city of Newark (population 182,000 in 1890) extends along the left bank of the river for a length of 6 miles from Newark Bay, and with its suburbs, Belleville, North Belleville, Avondale, and Rutherford Park, covers practically the whole river up to Passaic.

The natural available depth in this river up to Center Street Bridge, Newark, was 7 feet at mean low water; thence to the city of Passaic it was 3 feet, being limited by four bars.

The mean rise and fall of tides in Newark Bay is 4.7 feet; at Passaic it is about 3.3 feet.

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PROJECTS FOR IMPROVEMENT.

The river and harbor act of 1871 directed a survey of the Passaic River between Newark and Passaic, and under the appropriation of 1872 a project was adopted for deepening the channel to Passaic by dredging and diking to obtain a depth of 6 to 7½ feet, with width of 50 to 75 feet. The cost of this work, as revised in 1890, was estimated at $193,822.

In 1880 an appropriation was made for improving the river below Newark, and a project was adopted for dredging and diking to obtain a channel 200 feet wide and 10 feet deep at mean low water, from deep water in Newark Bay to Center Street Bridge, Newark. In 1884 the project was extended to include removal of shoals in Newark Bay, and the estimate of cost was increased to $353,875.

These two projects, at first distinct, were consolidated in 1892, and the total project for the improvement of the river is as follows:

To make a channel 200 feet wide and 10 feet deep at mean low water from deep water in Newark Bay to Center Street Bridge, Newark, by dredging and dike construction, and by similar means to make a channel from 200 to 50 feet wide and from 7½ to 6 feet deep from Center Street Bridge to the city of Passaic; estimated to cost, from the beginning of work in 1872, $547,697.

Details of location of the several bars in the stream and of the work done are given in the Annual Report of the Chief of Engineers for 1896, pages 770–772.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

At the beginning of the fiscal year dredging with the Government plant was in progress on the bar in Newark Bay, below Passaic Light. Work was continued until November 17, under the appropriation of 1896.

The total amount dredged during the fiscal year was 77,977 cubic yards, all from the shoal below Passaic Light. The total amount dredged from the date of beginning, May 26, 1896, to date of ceasing work, November 17, 1896, was 98,447 cubic yards.

A channel 200 to 250 feet wide and 12 to 13 feet deep at mean low water was dredged entirely through the shoal, which extended from a point 4,000 feet below the Passaic Light to opposite Twenty-fifth Street Dock, Bayonne, N. J., a distance of about 4,000 feet.

The cost of this work, exclusive of supervision, but including general repairs to the Government dredging plant, was 19½ cents per cubic yard, measured in scows.

PRESENT CONDITION OF IMPROVEMENT.

Channels of the full dimensions proposed have been dredged from deep water in Newark Bay to Center Street Bridge, Newark. Above Newark the required depth and width have been made, except at Rutherford Park Bar, where the minimum width is but 30 feet.

The dikes are in fair condition.

PROPOSED OPERATIONS.

Future appropriations should be applied to completing the project and to maintaining and keeping in repair the work already done.

Passaic River is in the collection district of Newark, which is the nearest port of entry. Nearest light-house, Passaic Light, at the lower end of dike in Newark Bay. Fort Tompkins, Staten Island, is the nearest fort.

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Money statement.

July 1, 1896, balance unexpended	$19,590.12
June 30, 1897, amount expended during fiscal year	19,228.65
July 1, 1897, balance unexpended	361.47
Amount (estimated) required for completion of existing project	94,347.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

Appropriations for improving Passaic River, New Jersey, have been made as follows:

	Below Newark.	Above Newark.	Total.
By act of Congress approved—			
June 10, 1872	.....	$25,000	$25,000
March 3, 1873	.....	25,000	25,000
June 23, 1874	.....	20,000	20,000
March 3, 1875	.....	20,000	20,000
August 10, 1876	.....	10,000	10,000
June 18, 1878	.....	10,000	10,000
March 3, 1879	.....	2,000	2,000
June 14, 1880	$30,000	2,000	32,000
March 3, 1881	50,000	.....	50,000
August 2, 1882	43,000	7,000	50,000
July 5, 1884	25,000	3,000	28,000
August 5, 1886	24,000	2,250	26,250
August 11, 1888	27,500	7,500	35,000
September 19, 1890	40,000	5,100	45,100
July 13, 1892 (for entire river)	.....	.....	45,000
August 17, 1894 (for entire river)	.....	.....	15,000
June 3, 1896 (for entire river)	.....	.....	15,000
Total	239,500	138,850	453,350

No contract for improving Passaic River, New Jersey, was in force during the fiscal year ending June 30, 1897.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

Freight received and shipped by water.

Articles.	Tons.	Value.
Building materials	297,725	$1,579,782
Ores and metals	124,725	13,403,700
Fertilizers	94,191	3,182,208
Coal	96,490	319,928
Miscellaneous merchandise	316,247	2,418,395
To and from Hackensack River	314,235	1,625,000
Total	1,243,613	22,478,963

These figures show a decrease in the tonnage of freight of 15,353 tons from that reported for the year 1895.

No new line of transportation is reported as established since July 1, 1896.

F 17.

IMPROVEMENT OF CHANNEL BETWEEN STATEN ISLAND AND NEW JERSEY.

Staten Island, New York, is separated from the State of New Jersey by a channel 17 miles long, extending along the west and north shores of Staten Island, from Perth Amboy, N. J., and Tottenville, Staten Island, to Constable Point (or Constable Hook), New Jersey, and New

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Brighton, Staten Island. The waterway is generally narrow, its least width being about 500 feet at a point between Elizabethport, N. J., and the northwest shore of Staten Island, 5½ miles west from New Brighton. There was a natural depth through this waterway of 15 feet or more at low tide, except for a length of about 1¾ miles opposite the mouth of Newark Bay and eastward from Elizabethport, where the natural available depth was 9½ feet in a narrow channel bordered by flats of 2 feet depth. The improvement of the channel between Staten Island and New Jersey consists in the deepening of the passage across this shoal.

The commercial importance of the channel between Staten Island and New Jersey results mainly from its being part of the inside water route between New York City and the coal wharves of the New Jersey Central Railroad at Elizabethport, of the Reading Railroad at Port Reading, of the Lehigh Valley Railroad at Perth Amboy, of the Pennsylvania Railroad at South Amboy, and the Raritan River and Delaware and Raritan Canal.

The mean rise of tide is about 5 feet.

PROJECTS FOR IMPROVEMENT.

A survey of the channel was made in 1872, and under authority of the river and harbor act of 1874 a project was adopted for making a channel 14 to 16 feet deep at mean low water by diking and dredging. The only work done under this project was the building of 2,237 linear feet of dike on the south side of the channel.

Under appropriations made by the river and harbor acts of 1876, 1878, and 1880, a project was adopted for making the channel 400 feet wide and 12 to 13 feet deep at mean low water by dredging, and protecting it by construction of four dikes at a total estimated cost of $185,705. This project was modified in 1883 to provide for a full depth of 13 feet and width of 400 feet, and the estimated cost was increased to $210,000. A further modification in 1889–90 provided for making the depth 14 feet at mean low water and for maintaining it by dredging without dikes.

By the terms of the river and harbor act of 1896, $5,000 of the appropriation made for the channel between Staten Island and New Jersey was to be applied to dredging in Lemon Creek, Staten Island, and the project was accordingly extended.

Up to July 1, 1896, the channel had been dredged 14 feet deep with full width of 400 feet in its western part and with 250 to 300 feet width east of the Corner Stake Light. The width has been reduced by material washed in from the adjacent flats.

Further details of work done are given in the Annual Report of the Chief of Engineers for 1896, pages 775–776.

Sketches of the channel between Staten Island and New Jersey were printed in the Annual Report of the Chief of Engineers for 1881, page 696, and for 1889, page 822.

Harbor lines in this channel have been established by the Secretary of War as follows: In Kill van Kull, January 4, 1890; in Arthur Kill, March 4, 1890; with modifications near Perth Amboy, August 9, 1892.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

The river and harbor act of 1896 appropriated $13,000 for improving the channel between Staten Island and the New Jersey shore, "out of which sum five thousand dollars shall be used in dredging Lemon Creek, on Staten Island." After an examination of Lemon Creek a project for its improvement was submitted providing for dredging a channel 8

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feet deep at mean high water (about 3¼ feet at mean low water), to be 50 feet wide from deep water in Princess Bay up to the drawbridge near the mouth of the creek, and above the drawbridge to be 35 feet wide for such a distance as the funds would admit. This project was approved by the Secretary of War September 1, 1896. Proposals for dredging were opened October 17, 1896, after due advertisement for bids. All bids received were rejected, the lowest, 37 cents per cubic yard, place measurement, being deemed excessive, and an offer made by Alonzo E. Smith to do the work at the rate of 25 cents per cubic yard, place measurement, was accepted, with approval of the Chief of Engineers.

Dredging was begun December 22, 1896, and continued until May 11, 1897, when the funds were exhausted. Seventeen thousand three hundred and sixteen cubic yards of material, place measurement, was excavated and thrown up into a bank upon the side of the channel. A channel 8 feet deep at mean high water was made 50 feet wide from Princess Bay to the entrance to Lemon Creek, a distance of 600 feet; thence to the drawbridge, a further distance of 250 feet. Above the bridge the channel was made 35 feet wide for a distance of 1,120 feet.

The rest of the appropriation, $8,000, was applied to dredging in the channel between Staten Island and New Jersey, in the vicinity of the Corner Stake Light. Work was done with the United States dredging plant, which began operations November 17, 1896, suspended for the winter December 29, 1896, resumed work April 12, and completed it April 30, 1897. The total amount dredged and deposited 2½ miles south of Coney Island, outside of New York Harbor, was 30,590 cubic yards. The cost, including repairs to the plant, was 25 cents per cubic yard, measured in scows. The channel east and west of the Corner Stake Light, for a total distance of 4,000 feet, was widened on the south side by an average width of 50 feet, making the minimum channel width at this locality 250 feet. The depth made was 14 feet at mean low water. The material removed was mud and sand, with a few bowlders, and for the most part was material which had washed in from the adjacent flats.

PRESENT CONDITION OF IMPROVEMENT.

The channel has a depth of 14 feet at mean low water and width of 250 feet for a distance of 400 feet abreast of the Corner Stake light. East of this section there is a minimum width of 300 feet to the Kill van Kull; west of the section, a minimum width of 350 feet to the Arthur Kill.

PROPOSED OPERATIONS.

It is proposed to apply future appropriations to dredging to remove the shoals which have formed in the channel and to widen the 14-foot channel to 400 feet, as contemplated in the approved project for improvement.

This work is in the collection district of New York. The nearest light-house is the Corner Stake light, on the south side of the improved channel. The nearest work of defense is Fort Tompkins, Staten Island.

Money statement.

July 1, 1896, balance unexpended	$13,063.80
June 30, 1897, amount expended during fiscal year	13,034.11
July 1, 1897, balance unexpended	29.69
Amount (estimated) required for completion of existing project	32,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	32,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

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Appropriations for improving the channel between Staten Island and New Jersey have been made as follows:

Application.	Date.	Amount.
For the first project:		
Diking	June 23, 1874	$50,000
For the present project:		
Dredging (not expended until 1881)	Aug. 14, 1876	10,000
Do	June 18, 1878	15,000
Do	June 14, 1880	29,000
Dredging	Aug. 2, 1882	40,000
Do	July 5, 1884	10,000
Do	Aug. 5, 1886	15,000
Do	Aug. 11, 1888	15,000
Do	Sept. 19, 1890	15,000
Do	July 13, 1892	15,000
Do	Aug. 17, 1894	6,000
Do	June 3, 1896	a 13,000
Total		183,000

a Of this amount $5,000 was appropriated for Lemon Creek, Staten Island.

Abstract of proposals for dredging Lemon Creek, Staten Island, opened by Maj. H. M. Adams, Corps of Engineers, Army Building, New York City, October 17, 1896.

No.	Name and address of bidder.	Price per cubic yard.	Amount removable under price bid ($4,500).	Remarks.
		Cents.	*Cubic yds.*	
1	Kaufman Simon, New York City	37	12,162	Prism measurement.
2	James McSpirit & Sons, Jersey City, N. J	39	11,538	Measured in place.

NOTE.—All bids rejected on account of excessive price, and dredging done under offer of A. E. Smith, at 25 cents per cubic yard, place measurement.

No contract for improvement of the channel between Staten Island and New Jersey has been in force during the past fiscal year.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

[Compiled from individual statements, representing 95 per cent of the total tonnage, furnished by parties making shipment over this waterway.]

Articles.	Tons.	Value.
Coal	6,960,412	$25,242,658
Building materials	762,774	3,823,626
Fertilizers	176,075	1,582,760
Oils	366,360	7,263,654
Grain	477,500	12,458,000
Miscellaneous	509,982	16,903,633
Total	9,253,103	67,274,131

The above total shows a decrease of 611,961 tons from that reported for the year 1895.

The above commerce was carried in vessels of from 5 to 23 feet draft.

No new line of transportation is reported established since July 1, 1896.

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F 18.

IMPROVEMENT OF ELIZABETH RIVER, NEW JERSEY.

Elizabeth River is a small creek in the eastern part of the State of New Jersey, which flows eastwardly and discharges into Arthur Kill at Elizabethport. From Broad Street Bridge, Elizabeth, to its mouth, a distance of 2.7 miles, the width of the stream is from 50 to 90 feet, and in the upper mile of this distance the natural bottom was bare at low tide.

The mean rise of tide at the mouth of the stream was 4.7 feet; at Broad street it was 3.4 feet.

PROJECT FOR IMPROVEMENT.

A survey of Elizabeth River was ordered by Congress in 1878, and under the terms of the river and harbor act of 1879 a project was adopted for making a channel 60 feet wide and 7 feet deep at mean high water up to the Broad Street Bridge, Elizabeth, at an estimated cost of $25,530. In 1881 this estimate was increased to $43,160.

During the progress of the work since 1879 several parts of the river have required dredging a second time to remove deposits from the banks and from sewage, and a bed of rock has been encountered in the vicinity of the South Street Bridge with depths from 1 to 3 feet less than the required depth.

Up to July 1, 1896, the channel had been made 7 feet deep at mean high water and from 30 to 60 feet wide up to Bridge street by repeated dredging and by removal of rock. Owing to shoaling, the available depth had been reduced to 5 feet at high water.

Additional details of work done are given in the Annual Report of the Chief of Engineers for 1896, pages 778, 779.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

The river and harbor act of 1896 contained an appropriation of $3,160 for completing the improvement of Elizabeth River, New Jersey. After duly advertising, proposals for dredging were received and opened April 2, 1897. The bids were all rejected by authority of the Chief of Engineers, and proposals were invited a second time, under the same specifications. Under date of May 12, 1897, a contract was entered into with James McSpirit for dredging about 8,000 cubic yards of material, prism measurement, at the rate of 34 cents per cubic yard; contract approved by the Chief of Engineers May 17, 1897, and expiring September 14, 1897.

Work under this contract has not yet been begun.

PRESENT CONDITION OF IMPROVEMENT.

A channel of the required depth, 7 feet at mean high water, and from 30 to 60 feet wide has been made from the mouth up to Bridge street, Elizabeth, by dredging at shoal places above the New York and Long Branch Railroad Bridge. This channel can not be maintained without frequent redredging, and at present the available depth in the shoalest part of the stream, between the foot of John street and the South Street Bridge, is but 5 feet at mean high water. At other points nearly the required depth exists, but the width has decreased.

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PROPOSED OPERATIONS.

Under the existing contract shoals in the previously dredged channel will be removed, making a depth of 7 feet at mean high water up to South street, Elizabeth, with width as great as the funds will permit. This work will not complete the improvement as originally projected.

Elizabeth River is in the collection district of Newark, N. J. The nearest lighthouse is the Corner Stake Light on the north shore of Staten Island, New York, and the nearest work of defense is Fort Tompkins, Staten Island, New York.

Money statement.

July 1, 1896, balance unexpended	$3,221.39
June 30, 1897, amount expended during fiscal year	32.30
July 1, 1897, balance unexpended	3,189.09
July 1, 1897, amount covered by uncompleted contracts	2,800.00
July 1, 1897, balance available	389.09

Appropriations for improving Elizabeth River, New Jersey, have been made as follows:

Application.	Date.	Amount.
Dredging, railroad bridge to above John street	Mar. 3, 1879	$7,500
Dredging, below South street	June 14, 1880	7,500
Dredging, below and above South street	Mar. 3, 1881	4,000
Dredging, South street to Bridge street	Aug. 2, 1882	8,000
Dredging, shoals below Bridge street	Sept. 19, 1890	5,000
Dredging, between South street and Bridge street bridges	July 13, 1892	5,000
Dredging, near South street	Aug. 17, 1894	3,000
Not yet expended	June 3, 1896	3,160
Total		43,160

Abstract of proposals for dredging in Elizabeth River, New Jersey, opened by Maj. H. M. Adams, Corps of Engineers, Army Building, New York City, April 2, 1897.

[Amount available, $2,800.]

Name and address of bidder.	Rate per cubic yard (prism measurement).	Number of cubic yards to be removed under price bid.
James McSpirit, Jersey City, N. J	$0.34	8,235
E. M. Payn, Albany, N. Y	*a* 1.25	2,240
Alonso E. Smith, Islip, N. Y	.49 1/10	5,611
Kaufman Simon, New York City	.17	16,470

a Scow measurement.

NOTE.—All the bids were rejected by authority of the Chief of Engineers.

Abstract of proposals for dredging in Elizabeth River, New Jersey, opened by Maj. H. M. Adams, Corps of Engineers, Army Building, New York City, May 3, 1897.

[Amount available, $2,800.]

Name and address of bidder.	Rate per cubic yard (prism measurement.)	Number of cubic yards to be removed under price bid.
	Cents.	
James McSpirit, Jersey City, N. J *a*	34	8,235
Alonzo E. Smith, Islip, N. Y	45	6,222

a Lowest bid.

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Contract in force during the fiscal year ending June 30, 1897.

Contract for dredging about 8,000 cubic yards, at 34 cents per cubic yard, prism measurement. Name of contractor, James McSpirit; date of contract, May 12, 1897; date of approval, May 17, 1897; date of beginning work, not yet begun; date of expiration, September 14, 1897.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

Freight received and shipped by water.

Articles.	Tons.	Value.
Coal	18,000	$63,000
Lumber	6,700	72,000
Building materials	8,650	16,600
Miscellaneous	2,716	22,160
Total	36,066	173,760

The above freight is carried in vessels of from 4 to 7 feet draft.

The above figures show an increase of freight carried of 14,416 tons over the amount reported for 1895.

No new lines of transportation are reported as established since July 1, 1896.

F 19.

IMPROVEMENT OF RARITAN RIVER, NEW JERSEY.

The Raritan River is a stream of moderate size which flows eastward in a winding course through the central part of the State of New Jersey, and discharges into the west end of Raritan Bay, between the cities of Perth Amboy on the north shore and South Amboy on the south. The navigable part of the river is considered as extending up to the city of New Brunswick, about 12 miles above the mouth, though small boats can go up about 5 miles farther to a dam which serves to feed the Delaware and Raritan Canal. This canal has its eastern terminus and lock on the south shore of the Raritan River at New Brunswick, and is a waterway between the Delaware River and New York Harbor; it was built to a depth of 8 feet. Formerly it carried a very large amount of freight, over two and a half million tons being reported in 1871. Since then the canal has come into possession of the Pennsylvania Railroad Company and the water transportation across the State of New Jersey has decreased, though it continues to be large.

There were two bars in the lower part of the river which reduced the general depth of 10 feet or over to an available depth of 6½ feet, and in the upper half there were several shoals of about the same depth. The lower bars were mainly of sand, and the upper ones in many cases of a rather hard shale.

The mean rise of tide at South Amboy was 5.1 feet and at New Brunswick 5.56 feet; the water at New Brunswick was always fresh at low tide.

Sketches showing the full length of the Raritan River from New Brunswick to the mouth were printed in the Annual Report of the Chief of Engineers for 1885, page 760.

Harbor lines for the Raritan River from New Brunswick to the mouth were established by the Secretary of War June 19, 1890, and November 3, 1890; the harbor lines on the south shore, at the mouth, were modified by the Secretary of War December 26, 1895.

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Further descriptions of locations of bars, etc., on this river are printed in the Annual Report of the Chief of Engineers for 1896, page 781.

PROJECTS FOR IMPROVEMENT.

A survey of Raritan River for the improvement of New Brunswick Harbor was made in 1836, and in the following year $13,963 was appropriated for work, but the records of this office do not show what work was done.

A survey of the river was provided for by the river and harbor act of 1873, and under the act of 1878, making appropriation for improvement, a project was adopted for making a channel 200 feet wide and 10 feet deep at mean low water up to the city of New Brunswick, about 12 miles above the mouth of the river; the estimated cost was $2,093,662.05.

Up to July 1, 1896, four dikes had been built and a fifth partly completed. The channel had been made the full projected depth and width to and through the reef at Whitehead's Dock, about 8½ miles above the mouth of the river; above that point it had been made 100 feet wide and 10 feet deep to 1,100 feet below the canal lock at New Brunswick (a distance of 3 miles) and for 400 feet farther it had been made 60 feet wide and 9 feet deep. The Middle Ground Channel, 4 miles above the mouth of the river, and some of the channels near the head of the river had shoaled to about 1 foot less than the required depth.

Detailed descriptions of the work done are printed in the Annual Report of the Chief of Engineers for 1896, pages 781–782.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

Under the appropriations made by the river and harbor act of 1896, after advertisement, proposals for breaking rock were opened March 8, 1897, and a contract was entered into with P. Sanford Ross, for breaking about 12,700 tons of shale rock into pieces which can be handled by a dredge, at rate of 59 cents per ton of 2,000 pounds; contract dated March 13, 1897, approved by the Chief of Engineers March 20, 1897, and expiring August 31, 1897.

Work under this contract was begun March 22, 1897, and is still in progress; up to the close of the fiscal year 8,694 tons of rock had been broken.

Removal of broken rock was begun by the Government dredging plant May 10, and at the close of the fiscal year 7,249 tons of rock had been removed and deposited in the uncompleted dike.

The channel from 1,100 feet to 700 feet below the canal lock at New Brunswick, heretofore made 60 feet wide and 9 feet deep at mean low water, was widened to 100 feet with 10 feet depth. Work is still in progress extending the channel of the latter dimensions to a point 400 feet below the canal lock.

PRESENT CONDITION OF IMPROVEMENT.

Four dikes have been completed and the fifth has been built to a length of 1,850 feet, with 550 feet additional partly built. They are all in fair condition.

A channel of the full dimensions, 200 feet wide and 10 feet deep at low water has been dredged to a point just above Whitehead's Dock, about 8 miles from the river's mouth; and above that point the full

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depth, with 100 feet width, has been made to within 700 feet of the canal lock at New Brunswick, the limit of the project.

The Middle Ground Channel and the channels in the upper 2½ miles of the stream, excepting the rock cuts, have shoaled slightly and have now an available depth of about 9 feet.

PROPOSED OPERATIONS.

Future appropriations will be applied to maintaining the dikes and channels and extending the dredged channel to the canal lock at New Brunswick. No further extension of the dike is proposed, except as a convenient method of disposing of excavated materials.

The Raritan River is in the collection district of Perth Amboy, which is the nearest port of entry. The nearest light-house is Great Beds Light, in Raritan Bay. The nearest work of defense is Fort Hancock, Sandy Hook, New Jersey.

Money statement.

July 1, 1896, balance unexpended		$20,655.74
June 30, 1897, amount expended during fiscal year		8,739.23
July 1, 1897, balance unexpended		11,916.51
July 1, 1897, outstanding liabilities	$5,165.70	
July 1, 1897, amount covered by uncompleted contracts	2,370.54	
		7,536.24
July 1, 1897, balance available		4,380.27
Amount (estimated) required for completion of existing project		1,442,412.05
Amount that can be profitably expended in fiscal year ending June 30, 1899		50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

Appropriations for improving Raritan River, New Jersey, have been made as follows:

Application.	Date.	Amount.
Dredging and diking	June 18, 1878	$200,000
Dredging, diking, and rock excavation	Mar. 3, 1879	60,000
Dredging and rock excavation	June 14, 1880	100,000
Do	Mar. 3, 1881	25,000
Do	Aug. 2, 1882	25,000
Do	July 5, 1884	35,000
Do	Aug. 5, 1886	26,250
Mainly in rock excavation	Aug. 11, 1888	50,000
Do	Sept. 19, 1890	50,000
Do	July 13, 1892	40,000
Do	Aug. 17, 1894	20,000
Do	June 3, 1896	20,000
Total		651,250

In addition to the above, $13,963 was appropriated for improving New Brunswick Harbor, New Jersey, in 1836–37.

Abstract of proposals for breaking rock in Raritan River, New Jersey, opened by Maj. H. M. Adams, Corps of Engineers, Army Building, New York City.

[Amount available, $7,500.]

Name and address of bidder.	Price per ton of 2,000 pounds broken free for dredging.	Number of tons removable under price bid.
	Cents.	
Frank Pidgeon, Saugerties, N. Y.	77	9,740
P. Sanford Ross, Jersey City, N. J.*a*	59	12,712
William E. Hingston, Buffalo, N. Y.	68	11,029
James McSpirit, Jersey City, N. J	67	11,194

a Lowest bid.

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Contract in force during the fiscal year ending June 30, 1897.

Contract: Breaking rock (about 12,000 tons), at 59 cents per ton of 2,000 pounds. Name of contractor, P. Sanford Ross, of Jersey City, N. J.; date of contract, March 13, 1897; date of approval, March 20, 1897; date of beginning work, March 22, 1897; date of expiration of contract, August 31, 1897.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

Freights received and shipped by water.

[Estimated value, about $18,000,000.]

Articles.	Tons.
Coal, clay, ores, etc	400,301
Manufactures, mainly brick	489,683
Miscellaneous	246,990
Total	1,136,974

The above freight was carried in vessels making 12,334 trips.

These figures show an increase in tonnage of freight of 161,873 tons over the tonnage reported for 1895.

No new lines of transportation are reported as established since July 1, 1896.

F 20.

IMPROVEMENT OF SOUTH RIVER, NEW JERSEY.

The South River is a small stream in the central part of the State of New Jersey which flows northwardly and discharges into the Raritan River about 8 miles above the mouth of the Raritan. For the lower 6 miles of its course, from Old Bridge to the Raritan, the South River is a crooked tidal stream with low, marshy banks. It is a narrow stream, in places not over 100 feet wide. The establishment of large brickyards along its banks gives this river a commercial importance out of proportion to its size.

The mean rise of tide at the mouth of the South River is 5.3 feet; at Old Bridge it is 4.6 feet.

PROJECTS FOR IMPROVEMENT.

Under a project adopted by authority of the river and harbor act of 1871, a channel 6 feet deep at low water was made up to the village of Washington, by way of the "canal," a distance of 1½ miles. This was completed in 1874 at a cost of $20,000.

After a survey made in 1879, and under authority of the river and harbor act of 1880, a project was adopted for making a channel 100 feet wide from the mouth of the river to Old Bridge, a distance of 6.3 miles, to be 8 feet deep to Washington; thence to Bissetts (2 miles) to be 6 feet deep; and thence to Old Bridge to be 4 feet deep. The original estimate of cost, $194,595, was reduced in 1892 to $176,975, as a result of omitting part of the proposed dikes.

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Up to July 1, 1896, the six proposed dikes below Washington had been built, and the channel through the canal and up to Washington had been made 8 feet deep and from 50 to 75 feet wide; thence to Raritan River Railroad Bridge, about a mile above Washington, it had been made of the same width and 6 feet deep. No work had been done above the vicinity of the railroad bridge.

Sketches of the South River were printed in the Annual Report of the Chief of Engineers for 1882, page 678, and for 1885, page 764.

Detailed descriptions of the project and work done are printed in the Annual Report of the Chief of Engineers for 1896, pages 784, 785.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

Under the appropriation of $5,000, made by the river and harbor act of 1896, after advertising for proposals, a contract for dredging about 18,500 cubic yards of material was entered into with the Newburg Dredging Company, at the rate of 24½ cents per cubic yard, measured in scows; contract dated October 29, 1896, approved by the Chief of Engineers November 10, 1896, and expiring May 31, 1897. Dredging was begun and completed in November, 1896, 17,988 cubic yards of material being removed.

Shoals in the canal were removed, making a cut 2,200 feet long and 50 feet wide; a shoal at the head of the canal was deepened, making a cut 220 feet long and 25 feet wide, and a cut 500 feet long and 50 feet wide was made through a shoal in South River just below the head of the canal.

PRESENT CONDITION OF IMPROVEMENT.

The dikes are in fair condition. The available channel depth up to Washington is 8 feet at mean low water in a channel dredged 50 feet wide in November, 1896. From Washington to the Raritan River Railroad Bridge the available depth is about 5 feet; no work had been done above the bridge.

PROPOSED OPERATIONS.

Future appropriations should be applied to maintaining the present channels and dikes, and, whenever sufficient funds are available, to widening and extending the channels as projected.

The South River is in the collection district of Perth Amboy, N. J. The nearest light-house is Great Beds Light, in Raritan Bay. The nearest work of defense is Fort Hancock, Sandy Hook, New Jersey.

Money statement.

July 1, 1896, balance unexpended	$5,575.95
June 30, 1897, amount expended during fiscal year	4,993.15
July 1, 1897, balance unexpended	582.80
Amount (estimated) required for completion of existing project	88,975.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

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Appropriations for improving South River, New Jersey, have been made as follows:

Application.	Date.	Amount.
For the old project:		
Dredging	Mar. 3, 1871	$15,000
Do	Mar. 3, 1873	5,000
Total for old project		20,000
For the present project:		
Dredging and diking and correcting course of canal at its mouth	June 14, 1880	40,000
	Mar. 3, 1881	6,000
Diking in and at head of canal; dredging	Aug. 2, 1882	10,000
Dredging in and at head of canal	Aug. 5, 1886	5,000
Repairing dikes; dredging above Washington and at mouth of canal	Aug. 11, 1888	5,000
	Sept. 19, 1890	5,000
Dredging above Washington	July 13, 1892	7,000
Dredging at and below Washington	Aug. 17, 1894	5,000
Dredging below Washington	June 3, 1896	5,000
Total for present project		88,000

Abstract of proposals for dredging in South River, New Jersey, opened by Maj. H. M. Adams, Corps of Engineers, Army Building, New York City, October 19, 1896.

Name and address of bidder.	Price per cubic yard, scow measurement.	Amount removable under price bid ($4,500).
	Cents.	*Cubic yds.*
Edgar M. Payn, Albany, N. Y.	29.9	15,050
The Newburg Dredging Co., Newburg, N. Y. *a*	24.5	18,367
James McSpirit & Sons, Jersey City, N. J.	27	16,667

a Lowest bid.

Contract in force during the fiscal year ending June 30, 1897.

Contract: Dredging, 18,500 cubic yards, at 24½ cents per cubic yard, scow measurement; name of contractor, the Newburg Dredging Company; date of contract, October 29, 1896; date of approval, November 10, 1896; date of beginning work, October 31, 1896; date of expiration, May 31, 1897; work completed November 28, 1896.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

Freight received and shipped by water.

[Estimated value, about $1,200,000.]

Articles.	Tons.
Coal, ore, and mineral products	70,738
Manufactures (brick, etc.)	145,570
Miscellaneous	475
Total	216,783

The above freight is carried in vessels making 3,290 trips.

These figures show an increase in tonnage of freight over that reported for 1895 of 38,989 tons.

No new lines of transportation are reported as established since July 1, 1896.

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F 21.

IMPROVEMENT OF RARITAN BAY, NEW JERSEY.

Raritan Bay is the western part of the large triangular sheet of water opening into the ocean between Sandy Hook and Coney Island, the eastern part of which is commonly known as the Lower Bay, as it is the lower part of the approaches to New York City wharves. The greatest width of Raritan Bay, between Staten Island on the northwest shore and New Jersey on the southwest shore, is 5 miles, and its greatest length, east and west, is about 7 miles.

Raritan Bay had naturally a fairly straight channel of about 11 feet available depth at mean low water, but the line of deepest water followed the north or Staten Island shore for about 4½ miles from Perth Amboy and South Amboy to Seguine Point, where it was separated from deep water in the eastern part of the bay by a shoal a mile and a half broad, with a minimum channel depth of 14½ feet.

In 1880, before improvement was begun, 21 feet at low tide could be carried from Perth Amboy to Seguine Point, except over two shoals south and southeast from Wards Point (the southwest point of Staten Island); beyond Seguine Point the available depth was 14½ feet. From South Amboy to Great Beds Light, at the junction of the South Amboy and Perth Amboy channels, the depth was about 12 feet.

The mean rise of tide in Raritan Bay is about 5 feet.

PROJECTS FOR IMPROVEMENT.

A survey of Raritan Bay was ordered in 1880, and under the appropriation made by the river and harbor act of 1881, a project for improvement was adopted which provided for making a channel 300 feet wide and 21 feet deep at low water through the shoal off Seguine Point, at an estimated cost of $126,500; subsequently it was found that in order to make the channel of this depth complete two shoals off Wards Point required dredging, and the estimated cost was increased to $165,000.

Under authority of the river and harbor acts of 1890 and 1892 the project was extended to include making a channel between Great Beds Light and South Amboy, 300 feet wide and 15 feet deep at mean low water, and the total estimated cost from the beginning was increased to $357,875.

Under the terms of the river and harbor act of 1896 the project was modified to provide for a depth of 21 feet in the South Amboy Channel; the additional cost of this was estimated at $150,000, making the total cost from the beginning $507,875.

Up to July 1, 1896, these channels had been dredged to the width of 300 feet, with depth of 21 feet in Seguine Point and Wards Point channels, and depth of 15 feet in the South Amboy Channel. These channels had shoaled at the sides from 3 to 5 feet and at the center from 1 to 3 feet, but retained their full depth in mid-channel for most of their length.

Harbor lines along the shores of Raritan Bay have been established by the Secretary of War as follows:

North shore, March 4, 1890, and July 26, 1890.
At Perth Amboy, June 19, 1890.
South shore, June 19, 1890, and March 9, 1892.

Detailed descriptions of the locality and of the work done are printed in the Annual Report of the Chief of Engineers for 1896, pages 787–788.

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OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

The river and harbor act of 1896 appropriated $75,000 for continuing this improvement and provided that two-thirds of the amount should be expended in making 21 feet depth in the channel between South Amboy and Great Beds Light. In accordance therewith, after advertisement, proposals for dredging were received and opened September 5, and a contract was entered into with R. G. & J. S. Packard for excavating about 223,000 cubic yards of material from the South Amboy Channel, at the rate of 19¾ cents per cubic yard, measured in scows, and for excavating about 137,000 cubic yards from the Seguine Point Channel, at the rate of 16 cents per cubic yard, measured in scows; contract dated September 23, 1896, approved by the Chief of Engineers September 30, 1896, and expiring May 31, 1897.

Dredging at the Seguine Point Channel was begun October 8, 1896, and continued until January 4, 1897, when 137,235 cubic yards of material had been removed, deepening the shoals which had formed in the previously dredged channel and making a full depth of 21 feet at mean low water for 100 feet width and a depth of 19 feet or over for a width of 200 feet entirely across the shoal, a distance of about 9,000 feet.

Dredging in the South Amboy Channel was begun October 14, 1896, and completed March 3, 1897, 222,110 cubic yards of material having been removed. A channel of 100 feet width, along the inner section, 120 feet width, along the outer section, increased to 150 feet for a distance of 500 feet above and below the bend between the sections and 21 feet depth at mean low water, was made from deep water at South Amboy to deep water below Great Beds Light, a total distance of about 7,000 feet.

The total amount dredged under the contract was 359,345 cubic yards.

The material removed form Seguine Point Channel was a soft sandy mud, which had washed into the channel; that removed from the South Amboy Channel was hard sand, gravel, and hardpan for a distance of 2,000 feet along the outer section; the remainder was mud. About 60,000 cubic yards of material from the South Amboy Channel was placed against the shore for dock filling, all the rest dredged under the contract was deposited in deep water off Coney Island.

PRESENT CONDITION OF IMPROVEMENT.

Seguine Point Channel, about 9,000 feet long, had been dredged to 300 feet width and 21 feet depth, and had shoaled 3 feet or more; during the past year it was dredged 21 feet deep and 100 feet wide; for another 100 feet of width the depth is 19 feet or over, and for the other 100 feet it is about 18 feet.

The Wards Point channels, about 4,500 feet long, have been dredged 300 feet wide and 21 feet deep; they are in fair navigable condition.

The South Amboy Channel, about 7,000 feet long, is 21 feet deep for a width of 100 feet, and from 12 to 15 feet deep for an additional 200 feet width.

PROPOSED OPERATIONS.

Future appropriations will be applied to dredging to complete and maintain the channels, as contemplated in the adopted project.

Raritan Bay is in the collection district of Perth Amboy, which is the nearest port of entry.

Princess Bay Light is on the north shore of the bay and Great Beds Light-House is near its west end. The nearest works of defense are at Fort Hancock, Sandy Hook, New Jersey.

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Money statement.

July 1, 1896, balance unexpended	$75,034.21
June 30, 1897, amount expended during fiscal year	70,918.17
July 1, 1897, balance unexpended	4,116.04
July 1, 1897, outstanding liabilities	46.67
July 1, 1897, balance available	4,069.37

Amount (estimated) required for completion of existing project 130,375.00
Amount that can be profitably expended in fiscal year ending June 30, 1899 ..... 100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

Appropriations for improving Raritan Bay, New Jersey, have been made as follows:

Application.	Date.	Amount.
Dredging:		
Seguine Point Channel	Mar. 3, 1881	$50,000
Do	Aug. 2, 1882	50,000
Do	July 5, 1884	20,000
Ward Point channels	Aug. 5, 1886	37,500
Seguine Point and South Amboy channels	Aug. 11, 1888	25,000
Do	Sept. 19, 1890	40,000
Do	July 13, 1892	40,000
Do	Aug. 17, 1894	40,000
Do	June 3, 1896	75,000
Total		377,500

Abstract of proposals for dredging in Raritan Bay, New Jersey, opened by Maj. H. M. Adams, Corps of Engineers, Army Building, New York City, September 5, 1896.

[Amounts available: South Amboy Channel, $44,000; Seguine Point Channel, $22,000.]

Name and address of bidder.	South Amboy Channel.		Seguine Point Channel.	
	Per cubic yard.	Number of cubic yards.	Per cubic yard.	Number of cubic yards.
	Cents.		*Cents.*	
R. G. & J. S. Packard, New York City *a*	19¼	222,790	16	137,500
H. E. DuBois, jr., New York City			16.9	130,180

a Lowest bid. Accepted.

Contract in force during the past fiscal year ending June 30, 1897.

Dredging about 223,000 cubic yards of material from South Amboy Channel, at rate of 19¼ cents per cubic yard, scow measurement, and about 137,000 cubic yards from Seguine Point Channel, at rate of 16 cents per cubic yard, scow measurement. Name of contractor, R. G. & J. S. Packard, 130 Pearl street, New York City; date of contract, September 23, 1896; date of approval, September 30, 1896; date of beginning work, October 8, 1896; date of expiration, May 31, 1897.

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COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

Freights passing through the Raritan Bay Channels.

Articles.	Tons.	Value.
Coal, clay, ores, etc	3,619,165	$31,937,800
Building material	33,898	
Manufactures	542,783	
Miscellaneous	433,668	
Total	4,629,514	31,937,800

The tonnage reported for 1896 is 807,052 tons more than that reported for 1895.

The above commerce is carried in vessels of maximum draft of 23 feet; maximum tonnage, 2,600 tons. It is estimated that 25 per cent of the commerce passed through the Seguine Point Channel, 80 per cent through the South Amboy Channel, and 90 per cent through the Ward Point Channel.

No new line of transportation is reported established since July 1, 1896.

F 22.

IMPROVEMENT OF MATTAWAN CREEK, NEW JERSEY.

Mattawan Creek is a small tidal stream in the eastern part of the State of New Jersey, flowing northeastwardly through salt marshes and emptying in Raritan Bay at Keyport Harbor, New Jersey, about 10 miles west from Sandy Hook. The navigable part of the stream extends up to the bridge of the New York and Long Branch Railroad, about $1\frac{7}{8}$ miles above its mouth. This part of the creek had naturally a depth of 4 feet or more in the lower half of its course, except over a mud flat at the entrance extending out into Keyport Harbor, upon which the available depth was less than 3 feet. In the upper half there was a narrow channel of $3\frac{1}{2}$ feet depth to the steamboat dock at Mattawan, $1\frac{3}{4}$ miles above its mouth. Above the steamboat dock the depth decreased to less than 2 feet. The stream is narrow everywhere above its mouth, the widths generally ranging from 75 to 200 feet.

The mean rise of tide, practically uniform throughout the navigable part of the creek, is 4.9 feet.

PROJECTS FOR IMPROVEMENT.

Under provision of the river and harbor act of June 14, 1880, a survey of "Mattawan Creek, from Raritan Bay Channel to Central Railroad Bridge, head of navigation," was made. The report on this survey, printed in the Annual Report of the Chief of Engineers for 1881, page 720, stated that to improve this stream sufficiently for high-water navigation it would be necessary to make a channel of 4 feet depth at mean low water by dredging through the mud flat at the entrance and through the shoals above Winkson Creek (about seven-eighths of a mile from the mouth). The estimated cost of making this channel 100 feet wide up to Winkson Creek, and thence to the railroad bridge 75 feet wide, was $33,120.

This project was adopted under authority of the river and harbor act of 1881, which appropriated $15,000 for beginning the work. Subsequent appropriations, amounting altogether to the estimated cost, $33,120, were made and expended upon this work up to October, 1893, but on account of continued shoaling during the period from 1880 to 1893 a large part of the available funds had to be applied to redredg-

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ing the same channels, and it was not possible to make the full width and depth designed within the limits of the estimate.

July 1, 1896, the 4-foot channel was from 40 to 100 feet wide up to the steamboat dock at Mattawan. Above the steamboat dock the available depth was 1½ to 2 feet up to the railroad bridge, a distance of about 900 feet.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

The river and harbor act of 1896 appropriated $3,000 for this improvement. After due advertisement, proposals for dredging were received and opened in April, 1897, but all bids were rejected. Proposals were again invited under the same specifications, and a contract for dredging about 14,400 cubic yards of material was entered into with James McSpirit, of Jersey City, N. J., at the rate of 18¾ cents per cubic yard, prism measurement. Contract dated May 12, 1897, approved by the Chief of Engineers May 17, 1897, and expiring September 14, 1897.

Work under this contract has not yet been begun.

PRESENT CONDITION OF IMPROVEMENT.

There is now a channel 4 feet deep at mean low water up to the Mattawan Steamboat Dock, with widths from 40 to 100 feet. Above the steamboat dock for 500 feet there is a depth of 2 feet or more, and thence to the railroad bridge, about 400 feet, the available depth is 1½ feet.

PROPOSED OPERATIONS.

Under the existing contract the channel will be widened at the narrowest places, which are between Winkson Creek and the steamboat dock, and extended 400 feet above the steamboat dock, dredging to a depth of 4 feet at mean low water.

If further appropriations are made for continuing this work, they should be expended in maintaining a navigable channel of 4 feet depth at mean low water up to the Mattawan Steamboat Dock, or, if practicable, to the railroad bridge.

Mattawan Creek is in the collection district of Perth Amboy, N. J. The nearest light-house is Great Beds Light, in Raritan Bay. The nearest work of defense is Fort Hancock, Sandy Hook, New Jersey.

Money statement.

July 1, 1896, balance unexpended	$3,141.51
June 30, 1897, amount expended during fiscal year	7.65
July 1, 1897, balance unexpended	3,133.86
July 1, 1897, amount covered by uncompleted contracts	2,700.00
July 1, 1897, balance available	433.86

Appropriations for improving Mattawan Creek, New Jersey, have been made as follows:

Application.	Date.	Amount.
Dredging	Mar. 3, 1881	$15,000
Do	Aug. 2, 1882	6,000
Do	Sept. 19, 1890	2,500
Do	July 13, 1892	9,620
Do	Aug. 17, 1894	3,000
Not yet expended	June 3, 1896	3,000
Total		39,120

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Abstract of proposals for dredging in Mattawan Creek, New Jersey, opened by Maj. H. M. Adams, Corps of Engineers, Army Building, New York City, April 2, 1897.

[Amount available, $2,700.]

Name and address of bidder.	Rate per cubic yard.	Number of cubic yards under bid.	Remarks.
	Cents.		
James McSpirit, Jersey City, N. J.	18¾	14,400	Prism measurement.
E. M. Payn, Albany, N. Y.	65	4,145	Scow measurement.
Alonzo E. Smith, Islip, N. Y.	29½	9,153	Prism measurement.
Kaufman Simon, New York City	17	15,882	Do.

All bids rejected.

Abstract of proposals for dredging in Mattawan Creek, New Jersey, opened by Maj. H. M. Adams, Corps of Engineers, Army Building, New York City, May 3, 1897.

[Amount available, $2,700.]

Name and address of bidder.	Rate per cubic yard.	Number of cubic yards under bid.	Remarks.
	Cents.		
James McSpirit, Jersey City, N. J. *a*	18¾	14,400	Prism measurement.
Alonzo E. Smith, Islip, N. Y.	20	14,000	Do.

a Lowest bid. Accepted.

Contract in force during the fiscal year ending June 30, 1897.

Contract for dredging about 14,400 cubic yards, at 18¾ cents per cubic yard, prism measurement. Name of contractor, James McSpirit, Jersey City, N. J.; date of contract, May 12, 1897; date of approval, May 17, 1897; date of beginning work, not yet begun; date of expiration, September 14, 1897.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

Freight received and shipped by water.

Articles.	Tons.	Value.
Grain	30,000	$4,250,000
Lumber	5,000	
Brick and building materials	25,000	
Farm produce, fertilizers, and miscellaneous merchandise	375,000	
Total	435,000	

The above figures show an increase in tonnage of freights of 96,875 tons over that reported for 1895.

No new lines of transportation are reported as established since July 1, 1896.

F 23.

IMPROVEMENT OF HARBOR AT KEYPORT, NEW JERSEY.

Keyport Harbor is a bay about a mile broad in the south shore of Raritan Bay and 10 miles west from the Atlantic Ocean at Sandy Hook, New Jersey. Keyport, a village of 3,200 population, lies on the southeast shore of the harbor. There was naturally no distinct channel in

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the harbor, and the available depth to the Keyport wharves was less than 4 feet at low water.

The mean rise of tide is 4.9 feet.

PROJECTS FOR IMPROVEMENT.

Under provision of the river and harbor act of June 10, 1872, a survey of Keyport Harbor was made, the report on which, printed in the Annual Report of the Chief of Engineers for 1873, page 941, stated that the available depth to the wharves was nearly 6 feet at low water in a channel dredged at private expense in 1866. This depth was not sufficient for the commerce of the harbor, and an estimate was presented for dredging a channel 8 feet deep at mean low water and 200 feet wide up to the Steamboat Dock, at a cost of $30,475.

This project was adopted under the river and harbor act of 1882, which appropriated $30,475 for completing the work. It was found that the channel had shoaled about 2 feet since 1872, and that $10,000 additional would be required to complete it, making the total cost $40,475.

The present project is the project adopted in 1882, with revised estimate of cost, and consists in dredging to make a channel 200 feet wide and 8 feet deep at mean low water up to the Steamboat Dock at Keyport, at an estimated cost of $40,475.

After 1882 no further appropriation for this improvement was made until 1892, during which interval the channel had filled along the sides.

Subsequent appropriations have been expended under the project, and up to July 1, 1896, the channel between the Keyport Steamboat Dock and Raritan Bay, a distance of 5,000 feet, had been dredged 8 feet deep at mean low water, with width of 200 feet in the outer part (4,200 feet long) and 160 feet wide in the inner part. It had shoaled so that the outer half had an available depth of 7¾ feet and the inner half a depth of 8 feet for a width of about 35 feet, and a depth of 6 feet for 110 feet width.

Harbor lines for the south shore of Raritan Bay, including Keyport Harbor, were established by the Secretary of War March 9, 1892.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

Under the appropriation of $2,500, made for this improvement by the river and harbor act of 1896, proposals for dredging were received and a contract for the removal of about 12,000 cubic yards of material, at the rate of 18 cents per cubic yard, measured in scows, was entered into with William H. Taylor, jr., of Jersey City, N. J.; contract dated April 14, 1897, approved by the Chief of Engineers April 26, 1897, and expiring July 1, 1897.

Work under this contract was begun May 21 and completed June 1, 1897, 12,222 cubic yards of material being excavated. A channel 75 feet wide and 1,100 feet long was dredged outward from the Steamboat Dock, overlying the channel dredged in February, 1896, which had almost completely filled up; the depth made was 8 feet at mean low water, where the depth before dredging ranged from 6 to 7 feet.

PRESENT CONDITION OF IMPROVEMENT.

The inner part of the channel recently dredged has a depth of 8 feet at mean low water with width of 75 feet for a length of 1,100 feet; outside of this the available depth is 7 to 8 feet.

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PROPOSED OPERATIONS.

The amount estimated for completion of this improvement has been appropriated and expended upon the work. During the period of execution of this work, from 1882 to 1896, the channel shoaled, and recent appropriations have not been sufficient to wholly remove the deposits. Therefore it has not been possible to dredge the channel to the projected depth and width within the estimated cost.

If further appropriations are made for this work they should be applied, in the first place, to such dredging as is necessary to maintain a channel 8 feet deep and of width as great as may be from Raritan Bay to the wharves at Keyport.

Keyport Harbor is in the collection district of Perth Amboy, N. J. The nearest light-house is Great Beds Light, in Raritan Bay; the nearest work of defense is Fort Hancock, Sandy Hook, New Jersey.

Money statement.

July 1, 1896, balance unexpended	$2,705.68
June 30, 1897, amount expended during fiscal year	2,489.29
July 1, 1897, balance unexpended	216.39
July 1, 1897, outstanding liabilities	6.67
July 1, 1897, balance available	209.72

Appropriations for improving Keyport Harbor, New Jersey, have been made as follows:

Application.	Date.	Amount.
Dredging	Aug. 2, 1882	$30,475
Do	July 13, 1892	5,000
Do	Aug. 17, 1894	5,000
Do	June 3, 1896	2,500
Total		42,975

Abstract of proposals for dredging in Keyport Harbor, New Jersey, opened by Maj. H. M. Adams, Corps of Engineers, Army Building, New York City, April 2, 1897.

[Amount available, $2,200.]

Name and address of bidder.	Rate per cubic yard (scow measurement).	Number of cubic yards under price bid.
	Cents.	
James McSpirit, Jersey City, N. J.	21	10,476
Alonzo E. Smith, Islip, N. Y.	25	8,800
Wm. H. Taylor, jr., Jersey City, N. J. *a*	18	12,222

a Lowest bid; accepted.

Contract in force during the fiscal year ending June 30, 1897.

Contract for dredging about 12,000 cubic yards of materials, at 18 cents per cubic yard, scow measurement. Name of contractor, Wm. H. Taylor, jr., of Jersey City, N. J.; date of contract, April 14, 1897; date of approval, April 26, 1897; date of beginning work, May 21, 1897; date of expiration of contract, July 1, 1897.

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COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

Freight received and shipped by water.

Articles.	Tons.	Value.
Produce	60,700	$1,500,000
Fertilizers	8,000	10,000
Coal and lumber	8,500	57,000
Fish and shellfish	10,000	425,000
Miscellaneous merchandise	18,000	980,000
Reported to and from Mattawan Creek	435,000	4,250,000
Total	540,200	7,222,000

The above freights were carried in vessels of from 3 to 11 feet draft.

The above figures show a decrease in the tonnage of freights carried to and from Keyport Harbor of 1,400 tons from that reported for the year 1895; an increase of 202,175 tons is reported in the freights passing through Keyport Harbor to and from Mattawan Creek.

No new lines of transportation have been reported as established since July 1, 1896.

F 24.

IMPROVEMENT OF SHOAL HARBOR AND COMPTON CREEK, NEW JERSEY.

Shoal Harbor, New Jersey, at the mouth of Compton Creek, is on the south side of Raritan and Sandy Hook bays, where they meet, 5 miles west-southwest from the Atlantic Ocean at Sandy Hook. The only natural harbor is inside the mouth of the creek, where the depth is from 3 to 6 feet at low tide. Compton Creek is navigable for rather more than a quarter of a mile above its mouth to a point where it is crossed by a highway bridge without a draw; the width of the creek below the bridge averages about 80 feet. The entrance to this small harbor was obstructed by a broad, flat shoal, extending generally along the south shore of Sandy Hook Bay, and the distance between deep water in the creek and 4 feet depth in the bay was about half a mile. The available depth across this shoal was less than 1 foot at mean low tide.

The village of Port Monmouth, lying west of the mouth of the creek, is the shipping point for garden truck from the adjoining country and for fish and oysters taken in the bay near by.

The mean rise of tide is about 4½ feet.

PROJECT FOR IMPROVEMENT.

Under provision of the river and harbor act of 1882 a survey of Shoal Harbor and Compton Creek was made. The report on the survey proposed a plan for improvement to secure a channel 5 feet deep at mean low water, to be 150 feet wide through the outer shoal and 75 feet wide in the creek, by dredging and by building a dike 3,200 feet long on the northwest side of the channel, at an estimated cost of $64,130.

The first appropriation made by Congress for carrying out this improvement was by act of September 19, 1890, which directed its application "so as to give a channel 4 feet deep at mean low water." A project for improvement was accordingly adopted for securing a channel 4 feet deep at mean low water and from 75 to 150 feet wide, connecting Compton Creek with Sandy Hook Bay, at an estimated cost of $64,130. This project has not been modified.

Up to July 1, 1896, a channel 1,650 feet long, 75 feet wide, and 4 feet

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deep at mean low water, had been dredged from Compton Creek outward, extending to the 1-foot curve in the bay.

Harbor lines in Sandy Hook Bay at Shoal Harbor were established by the Secretary of War March 9, 1892.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

Under the appropriation of $5,000 made by the river and harbor act of 1896, after due advertisement, proposals for dredging were received and opened August 24, 1896. But one bid was received, at a price of 76 cents per cubic yard, prism measurement. With the approval of the Chief of Engineers, this bid was rejected and authority to hire a dredge in open market was given, and a subsequent offer of the Newburg Dredging Company to do the work under the same specifications at the rate of 60 cents per cubic yard, measured in scows, was accepted. Dredging began October 6 and was completed October 23, 1896, after 7,500 cubic yards of material had been removed.

A cut 25 feet wide and 4 feet deep at mean low water was made, beginning at the steamboat dock and extending outward through Shoal Harbor a distance of 1,200 feet along the center of the previously dredged channel from Compton Creek, which had shoaled to a depth of 2.5 feet at mean low water.

Continuing the improvement, a channel 75 feet wide and 4 feet deep at mean low water was made, extending from the outer limits of the previously dredged channel a distance of 425 feet outward toward deep water in Raritan Bay and terminating at the 2-foot contour, distant 2,000 feet from the mouth of Compton Creek.

PRESENT CONDITION OF IMPROVEMENT.

The channel connecting Compton Creek with the bay has a depth of 4 feet at mean low water and width of 25 feet to 75 feet as far as dredged, to the 2-foot curve in the bay.

PROPOSED OPERATIONS.

Future appropriations should be applied to completing the projected channel.

Shoal Harbor is in the collection district of Perth Amboy, N. J. The nearest lighthouse is the Navesink Lights, and the nearest work of defense is Fort Hancock, Sandy Hook, New Jersey.

Money statement.

July 1, 1896, balance unexpended	$5,066.09
June 30, 1897, amount expended during fiscal year	5,007.21
July 1, 1897, balance unexpended	58.88
Amount (estimated) required for completion of existing project	48,130.00
Amount that can be profitably expended in fiscal year ending June 30, 1899	15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

Appropriations for improving Shoal Harbor and Compton Creek, New Jersey, have been made as follows:

Application.	Date.	Amount.
Dredging	Sept. 19, 1890	$5,000
Do	July 13, 1892	3,000
Do	Aug. 17, 1894	3,000
Do	June 3, 1896	5,000
Total		16,000

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Abstract of proposals for dredging in Shoal Harbor and Compton Creek, New Jersey, opened by Maj. H. M. Adams, Corps of Engineers, Army Building, New York City, August 24, 1896.

[Amount available, $4,500.]

Name and address of bidder.	Rate per cubic yard (prism measurement).	Number of cubic yards to be removed under price bid.
Kaufman Simon, New York City*	$0.76	5,921

*Only bid.

No contract has been in force for this work during the fiscal year ending June 30, 1897; dredging was done under open-market agreement, with approval of the Chief of Engineers, dated August 27, 1896; work begun October 6, 1896; completed October 23, 1896.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

Articles.	Amount.	Value.
	Tons.	
Farm produce	60,000	$175,000
Fish and shellfish	70,000	100,000
Coal	4,000	12,000
Fertilizers	25,000	30,000
Miscellaneous	8,000	20,000
Total	167,000	337,000

The above freights were carried in boats of from 2 to 4 feet draft.

This statement shows an increase in tons of freight carried of 15,000 tons over that reported for 1895.

No new lines of transportation are reported as established since July 1, 1896.

The number of vessels using Compton Creek as a harbor of refuge increased largely during the year 1896, owing to the improvement effected in the channel through Shoal Harbor, by way of which the creek is entered.

F 25.

IMPROVEMENT OF SHREWSBURY RIVER, NEW JERSEY.

The Shrewsbury River is a large tidal basin in the eastern part of the State of New Jersey. It consists of two bays of nearly equal area, about 3 square miles each, known as the North Branch (or Navesink River) and the South Branch, and of a channel called the "Main Stem," which unites the two branches at their east ends and extends northwardly to the southeast end of Sandy Hook Bay. The two branches of the river are separated by a hilly peninsula about 2 miles wide, and the main stem is separated from the Atlantic Ocean by a low sand beach, generally from 200 to 400 feet wide. In 1782 it is said that the river had a direct outlet to the ocean through this beach, at a point opposite the junction of the North and South branches. The outlet advanced northwardly, and a United States Coast Survey map of 1840 shows it to be north of the North Branch and nearly opposite the Navesink (or Highland) Lights. Some years later the direct outlet to the ocean closed up, and a Coast Survey map of 1864–65 shows that the present channel into Sandy Hook Bay had become the only outlet of the river.

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The mean rise of tide in Shrewsbury River, as observed in 1879, is as follows:

	Feet.
At the outer bar	5
At Highlands Bridge	3
At Seabright Bridge	1.3

PROJECTS FOR IMPROVEMENT.

A survey of the river was ordered by Congress in 1870, and under appropriations made in 1871 and 1873, amounting to $19,000, dredging was done upon six bars in the river.

The river and harbor act of 1875 provided for a survey of the "North and South branches of Shrewsbury River." A plan for improvement was proposed at an estimated cost of $18,000, which sum was appropriated in 1878. A more extended plan of improvement, referred to the Board of Engineers and approved by them February 12, 1879, was adopted March 3, 1879, when Congress appropriated funds for beginning work. This project provided for diking and dredging to make the channel 6 feet deep, with width of 300 feet in the main stem and of 150 feet in the North and South branches, at an estimated cost of $142,086. Owing to the facts that redredging on many of the shoals has been required and that the cost of dredging has proven greater than anticipated, the estimated cost has been increased to $234,062.

Up to July 1, 1896, the several channels had been dredged at different times to 6 feet depth, with widths from 60 to 200 feet, and nine dikes had been built with an aggregate length of 13,589 feet.

Harbor lines were established in the Shrewsbury River in the vicinity of Seabright by the Secretary of War February 5, 1894, and at the mouth of the river, along the west shore up to the Highland Bridge, March 9, 1892.

Sketches of Shrewsbury River were printed in the Annual Reports of the Chief of Engineers for 1879, 1881, 1882, 1887, 1890, 1891, and 1893.

Further and more detailed description of the locality and of the work done is printed in the Annual Report of the Chief of Engineers for 1896, pages 797–798.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1897.

The river and harbor act of June 3, 1896, appropriated $15,000 for continuing this improvement.

By approval of the Chief of Engineers, dated July 18, 1896, the expenditure of an amount not exceeding $1,000 was authorized, to afford immediate relief to traffic, which was obstructed by two small sand bars. Offers were invited from four contractors who owned suitable plants, and the offer of Mr. K. Simon, of New York City, to do the work at the rate of 46 cents per cubic yard, scow measurement, was accepted. Dredging was begun August 3, and completed August 30, 1896, 2,145 cubic yards of sand being removed and deposited behind Dike C. A cut 90 feet long and 100 feet wide was made through the shoal at Lower Rocky Point, and a cut 80 feet long and 75 feet wide through the shoal near Upper Rocky Point; depth made, 6 feet at mean low tide.

A survey of part of the river, to cost not exceeding $300, was authorized by the Chief of Engineers July 22, 1896, with a view to determining the best application of the available funds. The river from Oceanic to Lower Rocky Point was surveyed in the fall of 1896.

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During the winter of 1896–97 the sea broke through the neck of the Sandy Hook peninsula, nearly opposite Island Beach, and carried sand into the river, filling up the improved channel between Island Beach and the Sandy Hook peninsula to above ordinary high-water line, and leaving open a secondary outlet between the river and the ocean, with about 6 feet depth at low water. Navigation of this inlet is prevented by an outer bar and by the Government railroad trestle.

The available funds were not sufficient to close the breach nor to open the channel east of Island Beach, which latter would not in any case be advisable while the breach remained open.

The facts were reported to the Chief of Engineers February 27, 1897, with recommendation that the project be modified to provide for the improvement of the channel west of Island Beach until such time as it should be desirable to continue the improvement of the East Channel, and that so much as necessary of the available funds be applied to this work. This was approved by the Chief of Engineers March 1, 1897.

After advertisement for ten days proposals for dredging were received and a contract was entered into with Frank H. Brainard, of New York City, for dredging about 28,500 cubic yards from the main channel, at 28 cents per yard, scow measurement, and about 7,000 cubic yards from the North and South branches, at 35 cents per yard, scow measurement. Contract dated April 1, 1897, approved by the Chief of Engineers April 7, 1897, and expiring July 1, 1897. Dredging was begun April 7 deepening the main channel west of Island Beach.

The contractor's progress was not such as required by the contract, and he was warned that unless satisfactory progress was made at once measures would be taken to secure the completion of the work, under a provision of the contract. When it appeared that the contractor was unable to do the work more rapidly, offers were invited from others, and an offer of James McSpirit to dredge out the channel west of Island Beach, for 25 cents per cubic yard, was accepted May 1. Mr. McSpirit began work May 6. Both plants continued working until June 5, when the progress required by the contract was attained and the contractor's plant was transferred to the work in the North Branch. The hired dredge remained and completed the work in the main channel June 30. The amount removed from the main channel by the contractor was 11,998 cubic yards, by the hired dredge 18,000 cubic yards.

The total removed from the main channel west of Island Beach was 29,998 cubic yards. The mouth of the river was opened to navigation by a cut 6 feet deep at mean low water, 100 feet wide, and about 2,400 feet long, connecting the deep water at the end of the lower dike with that between Island Beach and the Highlands shore.

Dredging the North Branch under contract began May 6, was suspended from May 19 to June 6, and was completed June 23. Six thousand five hundred and twenty-four yards were removed. A cut 150 feet wide and 175 feet long was dredged to a depth of 9 feet at mean low water—3 feet more than the required depth, to allow for immediate shoaling. This made a channel sufficient for the needs of navigation across the shoal above Upper Rocky Point.

Dredging the South Branch under contract began June 24, and was in progress at the close of the month. By the removal of 1,085 cubic yards the channel opposite the stone dike above Seabright was given a width of 90 feet where the width was 45 feet for a distance of 150 feet, and a depth of 6 feet at mean low water. The total removed from the North and South branches was 7,609 cubic yards.

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PRESENT CONDITION OF IMPROVEMENT.

The dikes are in fair condition, some of them needing slight repairs. The channel through the main stem of the river by way of the cut west of Island Beach has an available depth of 6 feet at low water. In the North and South branches the available depth is about 5 feet over a few small shoals, which form after they are removed and render frequent dredging necessary.

PROPOSED OPERATIONS.

The estimated cost of the adopted project was $234,062, of which all but $62 has been appropriated. The project has not been completed, because frequent dredging has been required at several of the shoals, to prevent the entire destruction of traffic.

If further appropriations are made for this work, they should be applied to maintaining the dikes and redredging the shoals so as to give a depth of 6 feet at mean low water throughout the main channel and the North and South branches, with such width as may be practicable. The full projected width of 300 feet in the main channel and 150 feet in the branches is by no means as important as maintaining channels of navigable width, 100 to 150 feet, and of the full depth.

Shrewsbury River is in the collection district of Perth Amboy, N. J. The Navesink lights, on the west side of the river near its mouth, are the nearest light-houses. The nearest work of defense is Fort Hancock, Sandy Hook, New Jersey.

Money statement.

July 1, 1896, balance unexpended	$15,036.02
June 30, 1897, amount expended during fiscal year	7,289.03
July 1, 1897, balance unexpended	7,746.99
July 1, 1897, outstanding liabilities	6,570.79
July 1, 1897, balance available	1,176.20
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	62.00

Appropriations for improving Shrewsbury River, New Jersey, have been made as follows:

Application.	Date.	Amount.
For previous projects:		
Survey	Aug. 30, 1852	$1,500
Dredging	Mar. 3, 1871	14,000
Do	Mar. 3, 1873	5,000
Total		20,500
For existing project:		
Survey and diking	June 18, 1878	18,000
Diking and dredging	Mar. 3, 1879	10,000
Do	June 14, 1880	30,000
Do	Mar. 3, 1881	86,000
Do	Aug. 2, 1882	30,000
Diking	Aug. 5, 1886	10,000
Dredging	Aug. 11, 1888	10,000
Diking and dredging	Sept. 19, 1890	10,000
Repair of dikes and dredging	July 13, 1892	10,000
Do	Aug. 17, 1894	5,000
Dredging	June 3, 1896	15,000
Total		234,000

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Abstract of proposals for dredging in Shrewsbury River, New Jersey, opened by Maj. H. M. Adams, Corps of Engineers, Army Building, New York City, March 27, 1897.

[Amount available: Main channel, $8,000; North and South branches, $2,500.]

No.	Name and address of bidder.	Main channel.		North and South branches.	
		Rate per cubic yard (scow measurement).	Number of cubic yards under price bid.	Rate per cubic yard (scow measurement).	Number of cubic yards under price bid.
		Cents.		*Cents.*	
1	Alonzo E. Smith, Islip, N. Y.	49	16,327	55	4,545
2	Frank H. Brainard, New York City *a*.	28	28,571	35	7,143

a Lowest bidder.

Contract in force during the fiscal year ending June 30, 1897.

Dredging: Main channel, 28,500 cubic yards, at 28 cents per cubic yard, scow measurement; North and South branches, 7,000 cubic yards, at 35 cents per cubic yard, scow measurement. Name of contractor, Frank H. Brainard, New York City; date of contract, April 1, 1897; date of approval, April 7, 1897; date of beginning work, April 7, 1897; date of expiration of contract, July 1, 1897.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1896.

Freight received and shipped by water.

Articles.	Tons.	Estimated value.
Produce	290,000	$2,710,000
Fish and shellfish	11,520	948,500
Coal	19,620	81,400
Lumber	300	600
Building material	7,090	23,920
Miscellaneous	539,600	5,215,000
Total	868,130	8,979,420

Passengers carried, 350,000.

The above figures show an increase in tonnage of freight carried of 238,030 tons over that reported for 1895.

The above freights were carried in steamers and sailing vessels of from 3 to 5 feet depth.

No new lines of transportation are reported as established since July 1, 1896.

F 26.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

1. Wreck of schooner Lizzie D. Saunders, east of Branford, Conn.—Details concerning this wreck were printed in the Annual Report of the Chief of Engineers for 1896, pages 802–803. Proposals for removal were received June 26, 1896; but one offer was received, which was considered too high ($249) and was rejected.

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An informal offer from Mr. Thomas Scott, of New London, Conn., to do the work for $150 was received and accepted. The wreck was lifted by passing chains under it; it was raised from the bottom unbroken, attached to a wrecking barge, and towed out into Long Island Sound and sunk in 17 fathoms of water at a point 2½ miles south-southwest from Faulkners Island Light. The work was done July 20, 1896.

Nothing of value was found upon the wreck.

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2. Wreck of coal barge Mist, in Raritan Bay, New Jersey.—Details concerning this wreck were printed in the Annual Report of the Chief of Engineers for 1896, pages 801–802. At the date of that report the wreck had been completely removed, but a part of it had been left upon the shore, where it was considered liable to be carried back into the channel.

In July, 1896, the contractor had this piece of the wreck cut up and moved back above extreme high-water mark. The requirements of the contract were thus complied with and the work of removal was completed.

There was nothing of value found upon this wreck.

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3. Wreck of schooner Anna Augusta, in Raritan River, New Jersey.—This vessel, a small coasting schooner, was run down September 14, 1896, while at anchor and sank on the south side of the channel of Raritan River, about 1½ miles above the New York and Long Branch Railroad Bridge, where the low-water depth was about 13 feet.

Notification of this wreck was received in a letter of the inspector of the Third light-house district, which was forwarded to the Chief of Engineers with report dated September 23, 1896. By Department letter dated September 25, 1896, removal of the wreck was authorized and $500 was allotted for the purpose.

After advertisement, proposals for doing the work were received November 3, 1896, and the bid of Jacob Hanson, to remove the wreck for the sum of $227, was accepted.

The wreck was removed in January, 1897, and deposited behind the stone dike at the Middle Ground, Raritan River.

Nothing of value was found upon the wreck.

Abstract of proposals for removing wreck of schooner Anna Augusta, in Raritan River, New Jersey, received in response to advertisement of October 3, 1896, and opened November 3, 1896, by Maj. H. M. Adams, Corps of Engineers, Army Building, New York City.

Name and address of bidder.	Price.
John H. Gregory, Perth Amboy, N. J	$385
Jacob Hanson, Perth Amboy, N. J.*a*	227
John F. Baxter, New York City	320
R. G. & J. S. Packard, New York City	745

a Lowest bid; accepted.

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4. Wreck of the steam tug William Horre, in Gowanus Canal, New York Harbor.—This vessel was wrecked October 23, 1896, by a boiler explosion while at anchor, and sank in 12 feet depth of water, in Gowanus Canal, near the foot of Smith street, Brooklyn.

Notification of the wreck as a dangerous obstruction to navigation was received from the Board of Pilot Commissioners of New York, November 17, 1896. An estimate of cost of removal was submitted and $400 was allotted for the work by Department letter of December 24, 1896.

Proposals for removal of the wreck were invited by circular letter, December 31, 1896, and the offer of the Hudson River Lighterage Company, of New York City, to do the work for $150 was accepted. Work of removal was begun January 11, and completed January 17, 1897.

Nothing of value was found upon the wreck.

Abstract of proposals for removing wreck of steam tug William Horre, in Gowanus Canal, New York Harbor, received in response to circular letter of December 31, 1896, and opened January 6, 1897, by Maj. H. M. Adams, Corps of Engineers, Army Building, New York City.

Name and address of bidder.	Price.
Baxter Wrecking Co., New York City	$250
Chapman Derrick and Wrecking Co., New York City	375
Hudson River Lighterage Co., New York City *a*	150

a Lowest bid; accepted.

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5. Wreck of schooner John B. Conover, in Sheepshead Bay, New York.—On April 8, 1897, this vessel, with a cargo of brick, passing up Sheepshead Bay, struck bottom and sank on the south side of the channel, nearly opposite the upper end of Plum Island. The cargo was removed and the vessel abandoned, lying on beam ends in 8 to 16 feet of water at low tide.

Notification of the wreck was received in a letter from Mr. John D. Prince, jr., dated May 17, 1897. The wreck was reported to the Chief of Engineers, and by Department letter of May 29, 1897, funds for removal were allotted.

Proposals for removal were received June 17, 1897, and an offer of the Baxter Wrecking Company, to do the required work for $290, was accepted. Work was begun June 22, and completed June 28, 1897. The wreck was lifted by pontoons and towed away to a private dockyard at Weehawken, N. J.

The vessel was found to be badly strained and worthless. Nothing of value was on her.

Abstract of proposals for removing wreck of schooner John B. Conover, in Sheepshead Bay, New York, received in response to public notice, dated June 7, 1897, and opened June 17, 1897, by Maj. H. M. Adams, Corps of Engineers, Army Building, New York City.

Name and address of bidder.	Price.
Jacob Hanson, Perth Amboy, N. J	$445
John H. Gregory, Perth Amboy, N. J	460
Baxter Wrecking Co., New York City *a*	290
Frank McNeal, New York City	1,252

a Lowest bid; accepted.

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F 27.

PRELIMINARY EXAMINATION FOR CHANNEL CONNECTING FLUSHING BAY AND NEWTOWN CREEK, NEW YORK.

[Printed in House Doc. No. 60, Fifty-fourth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 3, 1896.

SIR: I have the honor to submit the accompanying copy of report, dated September 29, 1896, by Maj. H. M. Adams, Corps of Engineers, of the results of a preliminary examination for channel connecting Flushing Bay and Newtown Creek, New York, made to comply with provisions of the river and harbor act of June 3, 1896.

It is the opinion of Major Adams, concurred in by the division engineer, Col. John M. Wilson, Corps of Engineers, and by me, that the construction of a channel between Flushing Bay and Newtown Creek is not worthy to be undertaken by the United States under existing conditions.

Very respectfully, your obedient servant,

W. P. CRAIGHILL,
Brig. Gen., Chief of Engineers.

HON. DANIEL S. LAMONT,
Secretary of War.

REPORT OF MAJ. H. M. ADAMS, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
New York City, September 29, 1896.

GENERAL: I have the honor to submit the following report upon the preliminary examination for a channel connecting Flushing Bay and Newtown Creek, New York, ordered by the river and harbor act of June 3, 1896:

There is no channel now connecting these waters. They are separated by 4 miles of upland. The most practicable and economical course for a connecting channel would be, starting from a small cove just south of Sandfords Point, at the west side of the mouth of Flushing Bay, and extending in a general southwesterly direction to Newtown Creek, at a point in the "English Kills," 3,300 feet above the Meeker Avenue or "Penny" Bridge. A survey for a channel along this line was made some years ago (date not ascertained) by Cornelius Hyatt, civil engineer, for Messrs. Edward and Charles W. Cooper. They estimated that to cut a canal along this line 15 feet deep and 120 feet wide at bottom would cost, including land damages, approximately, $1,750,000. The greatest elevation along this profile, as shown on the Messrs. Cooper's map, is 59.7 feet above high water, and for over 14,000 feet the elevation is 10 feet or more.

An examination of the same locality was made in January and February, 1893, by John Bogart, civil engineer, for the State board of health of the State of New York, with a view to procuring a supply of pure water to carry off the foul waters of Newtown Creek. With the report upon this examination (printed in the Fourteenth Annual Report of the New York State Board of Health, vol. 1, p. 223) were submitted copies

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of the map made by Mr. Hyatt and tide observations made by Mr. Bogart. From these it appears that for about half the twenty-four hours there would be a flow of water from Flushing Bay to Newtown Creek, with a maximum (observed) head of 3.4 feet.

The limit of depth and width for a connecting channel between Flushing Bay and Newtown Creek, so far as navigation is concerned, would be 125 feet wide and 18 feet deep at mean low water, that being the dimensions of the Newtown Creek channel, authorized by the river and harbor act of 1896. It could not be constructed now at the cost estimated by the Messrs. Cooper for a smaller channel. It would probably cost all of this for excavation, exclusive of land damages, and, in addition, the banks would undoubtedly require extensive protection to prevent undermining, as the currents would be very rapid and the material of the channel bed would be mainly sand.

The benefit to navigation resulting from such a channel would be the affording of an inland waterway between the East River and Long Island Sound as an alternative to the passage via Hell Gate. There would be practically nothing saved in distance, and very little in the strength of adverse currents, but the dangers connected with the rocky shores of Hell Gate would be avoided.

The course of a connecting channel between Flushing Bay and Newtown Creek would be one which sailing vessels could follow only with fair wind and tide, and steamers could use the channel only at slow speed on account of washing the banks. The channel would have at least eight drawbridges, two of which would be railroad bridges, in addition to the three bridges in Newtown Creek below the channel outlet.

The Hell Gate passage has a depth of 30 feet or over, with a minimum width of 300 feet in two channels on either side of the Middle Ground; it has no bridges, and the available width is not reduced at the narrowest parts by vessels lying at the docks, as would be the case in Newtown Creek. The difference in time of passage between the proposed artificial channel and the natural channel via Hell Gate would be more than an hour in favor of the latter.

The amount of commerce passing through Hell Gate is very large; there are no accessible figures giving even a fair approximation of its amount. It is not to be presumed that a considerable part of this commerce would be directed into a narrower, shoaler, and more crooked artificial channel, spanned by eleven drawbridges, and at a loss of over an hour in the transit. There is no local commerce to be benefited.

A channel to connect Flushing Bay with Newtown Creek is much desired in some quarters as a means of freeing Newtown Creek from pollution by sewage and improving the sanitary condition of its vicinity. A canal for such a purpose should be provided with locks to prevent the foul water backing up toward Flushing Bay, which would be inconsistent with its present use for navigation.

For the reasons above stated, I do not consider the construction of a channel between Flushing Bay and Newtown Creek to be an improvement worthy to be undertaken by the United States under existing conditions, and no survey of the locality is recommended.

Very respectfully, your obedient servant,

H. M. ADAMS,
Major, Corps of Engineers.

Brig. Gen. W. P. CRAIGHILL,
Chief of Engineers, U. S. A.
(Through the Division Engineer.)

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[First indorsement.]

NORTHEAST DIVISION ENGINEER OFFICE,
Washington, September 30, 1896.

Respectfully forwarded to the Chief of Engineers.

For the reasons stated by Major Adams, I am of the opinion that this improvement is not worthy of being undertaken by the United States under existing conditions.

JOHN M. WILSON,
Colonel, Corps of Engrs., Division Engineer, N. E. Division.

F 28.

PRELIMINARY EXAMINATION OF ROSLYN HARBOR, NEW YORK.

[Printed in House Doc. No. 215, Fifty-fourth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., January 22, 1897.

SIR: I have the honor to submit the accompanying copy of report of January 15, 1897, by Maj. H. M. Adams, Corps of Engineers, of the results of a preliminary examination of Roslyn Harbor, New York, made in compliance with the requirements of the river and harbor act of June 3, 1896.

For the reason that the amount of commerce of this harbor is small, and that the delays and inconveniences to which it is now subject are slight as compared with the probable cost of making and maintaining a deeper channel, Major Adams is of the opinion that the improvement of Roslyn Harbor is a work not worthy of being undertaken by the United States.

His views are concurred in by the division engineer, Col. John M. Wilson, Corps of Engineers, and by me.

Very respectfully, your obedient servant,

W. P. CRAIGHILL,
Brig. Gen., Chief of Engineers.

Hon. DANIEL S. LAMONT,
Secretary of War.

REPORT OF MAJ. H. M. ADAMS, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
New York City, January 15, 1897.

GENERAL: I have the honor to submit the following report upon a preliminary examination of Roslyn Harbor, New York, made in compliance with the provisions of the river and harbor act of 1896:

Roslyn Harbor, a basin at the south end of Hempstead Harbor, is on the north shore of Long Island, and distant 27 miles by water from the Battery, New York City. It is separated from Hempstead Harbor by "Bar Beach," a sand spit 150 feet wide, extending 1,700 feet from the west shore, and leaving a 600-foot channel close to the

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east shore. Roslyn Harbor itself is nearly 2 miles long and has a width of 2,000 feet or over to within half a mile of its south end, where it is a narrow stream, which at low tide is mostly fresh water. In the south end of the harbor the bottom is bare at low tide all the way across; in the middle and north parts the depths are irregular, the bottom consisting of pockets 12 to 15 feet deep and of shoals 4 feet or less in depth, with the channel generally near the east shore. From Bar Beach out through Hempstead Bay to Long Island Sound the depths are over 12 feet. Roslyn is a village of about 1,500 population, located around the head of the harbor. It is claimed that the harbor in part supplies the country for 5 miles or more back from the water.

The improvement desired is the deepening of the channel to make it 8 feet deep to the steamboat dock, rather more than half way up the harbor, and thence to the head of the harbor to make it 5 feet deep, the object being to obviate occasional delays to the steamboat so that she could reach and leave her dock on schedule time, and to enable the using of larger vessels than now in freighting to the upper docks.

There are five landings in Roslyn which would be benefited by such a channel—the Roslyn steamboat dock, three-fourths of a mile from the head of the harbor, the terminal landing of a steamer which makes daily trips between New York City and several ports at the west end of Long Island Sound; the town dock, about one-fourth of a mile from the head of the harbor, and where the harbor narrows to a creek, and three private docks at the head of the harbor.

Following are the estimated amounts of commerce at these points:

Locality.	Kinds of freight.	Tons.	Estimated value.
Steamboat dock	Household goods, groceries, and miscellaneous	2,700	
Town dock	Fertilizers	7,000	$21,000
Private docks	Coal, building materials, feed, etc	11,700	91,600
Total		21,400	

None of this freight is of a perishable nature, such as would suffer by delays in waiting for high tide or by lightering.

The regular steamer is a boat of slightly over 5 feet draft and registers 742 tons gross tonnage. The other vessels bringing freights are generally schooners and barges of 4 to 6 feet draft. Lumber from Southern and Eastern ports is occasionally brought in a boat of 10 to 12 feet draft and has to be lightered or rafted.

The shipping of sand and gravel from the adjoining hills and the planting, gathering, and shipping of oysters are industries of some importance in this harbor, but they would be little affected by the desired improvement. Farm and garden produce for the market is generally transported overland in market wagons.

Under the provisions of the river and harbor act of 1880, a survey of Hempstead Harbor, including Roslyn Harbor, was made, the report on which was printed in the Annual Report of the Chief of Engineers for 1881, page 668. The improvement desired and the amount of commerce reported were very nearly the same then as now.

For the reasons that the amount of commerce of this harbor is small and that the delays and inconveniences to which it is now subject are slight as compared with the probable cost of making and maintaining a deeper channel, I am of the opinion that the improvement of Roslyn

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Harbor, New York, is not a work worthy to be undertaken by the United States.

Very respectfully, your obedient servant,

H. M. ADAMS,
Major, Corps of Engineers.

Brig. Gen. W. P. CRAIGHILL,
Chief of Engineers, U. S. A.
(Through the Division Engineer.)

[First indorsement.]

NORTHEAST DIVISION ENGINEER OFFICE,
Washington, January 16, 1897.

Respectfully forwarded to the Chief of Engineers.

For the reasons given by the local engineer I concur in his opinion that the improvement of Roslyn Harbor, New York, is not a work worthy to be undertaken by the United States.

JOHN M. WILSON,
Colonel, Corps of Engineers,
Division Engineer, Northeast Division.

F 29.

PRELIMINARY EXAMINATION OF HARBOR AT OYSTER BAY, NEW YORK.

[Printed in House Doc. No. 201, Fifty-fourth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., January 18, 1897.

SIR: I have the honor to submit the accompanying copy of report of January 8, 1897, by Maj. H. M. Adams, Corps of Engineers, of the results of a preliminary examination of harbor at Oyster Bay, New York, made to comply with the requirements of the river and harbor act of June 3, 1896.

It is the opinion of Major Adams, concurred in by the division engineer, Col. John M. Wilson, Corps of Engineers, and by me, that the improvement of the harbor upon the plan desired is not a work worthy to be undertaken by the United States.

Very respectfully, your obedient servant,

W. P. CRAIGHILL,
Brig. Gen., Chief of Engineers.

Hon. DANIEL S. LAMONT,
Secretary of War.

REPORT OF MAJ. H. M. ADAMS, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
New York City, January 8, 1897.

GENERAL: I have the honor to submit the following report upon the preliminary examination of harbor at Oyster Bay, New York, made in compliance with the provisions of the river and harbor act of 1896.

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Oyster Bay is a village with a population of about 3,000, situated on the south shore of Oyster Bay Harbor, a deep-water inlet on the north side of Long Island, 35 miles by water from the Battery, New York City. The harbor is completely landlocked and has a channel depth of 25 feet or more up to a point opposite the village, where the depth gradually shoals up to a low, flat shore. A few years ago the Long Island Railroad Company built a large wharf at Oyster Bay and dredged a channel to it of 14 feet depth and considerable width, as part of a projected through route between New York and Boston.

The project has been abandoned and the wharf removed, but there remains the deep channel up to a distance estimated at 450 feet from the steamboat wharf, the principal wharf of the village. This wharf is 250 feet long and 75 feet wide; it was built by a corporation or association in 1893, and the water front around the wharf was dredged 6 feet deep at low tide. The mean rise of tide is 7½ feet.

It is desired that the United States should make the channel up to and alongside this wharf from 8 to 9 feet deep at mean low water and 100 feet wide, with a turning basin 200 feet wide.

The commerce of Oyster Bay consists of coal, lumber, brick, and miscellaneous supplies, received for a community in and near the village estimated to number about 7,000; and of oysters, cord wood, posts, and telegraph poles shipped. No records of the amount of this commerce are kept, but it is estimated to be per year approximately as follows:

Articles.	Tons.	Value.
Coal	6,000	$30,000
Lumber, 900,000 feet	1,500	18,000
Cord wood, posts, etc.	700	5,000
Brick, oysters, ice, and miscellaneous steamer freights	30,000	1,000,000
Total	38,200	1,053,000

This freight is generally carried in schooners and barges of 6 to 8 feet draft and of 100 to 250 tons capacity, and in a small steamer, 6½ feet draft, 139 tons register, which makes regularly, during nine months of the year, three round trips weekly between Oyster Bay and New York City. Occasionally a cargo of lumber from Maine is brought in schooners of 12 to 15 feet draft; the lumber is rafted to the landings.

There is a small shipyard in Oyster Bay, where vessels up to 100 tons are repaired.

The object of the desired improvement is to bring a greater depth of water up to the steamboat wharf, where it is claimed the greater part of the water traffic of the village is done. The wharf is not public property, though it is open to all vessels upon payment of wharfage dues. To some extent it enters into competition with the smaller landings along the water front.

In my opinion the deepening of the approach to this wharf is a private enterprise, which should be done, if at all, by the owners of the wharf; and, for the reasons stated, I do not consider the improvement of the harbor at Oyster Bay, upon the plan desired, a work worthy to be undertaken by the United States.

Very respectfully, your obedient servant,

H. M. ADAMS,
Major, Corps of Engineers.

Brig. Gen. W. P. CRAIGHILL,
Chief of Engineers, U. S. A.
(Through the Division Engineer.)

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[First indorsement.]

NORTHEAST DIVISION ENGINEER OFFICE,
Washington, January 11, 1897.

Respectfully forwarded to the Chief of Engineers.

For the reason stated by the local engineer, I concur in his views that the improvement of the harbor at Oyster Bay, upon the plan desired, is not a work worthy to be undertaken by the United States.

JOHN M. WILSON,
Colonel, Corps of Engineers,
Division Engineer, Northeast Division.

F 30.

PRELIMINARY EXAMINATION OF LLOYDS HARBOR, WITH A VIEW TO ITS CONNECTION WITH COLD SPRING BAY, NEW YORK.

[Printed in House Doc. No. 204, Fifty-fourth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., January 19, 1897.

SIR: I have the honor to submit the accompanying copy of report of the 8th instant by Maj. H. M. Adams, Corps of Engineers, of the results of a preliminary examination of Lloyds Harbor, New York, with a view to its connection with Cold Spring Bay, made to comply with requirements of the river and harbor act of June 3, 1896.

Major Adams is of opinion that the connection of Lloyds Harbor with Cold Spring Bay by a navigable channel is not an improvement worthy to be undertaken by the United States, and his opinion is concurred in by Col. John M. Wilson, Corps of Engineers, Division Engineer, and by me.

Very respectfully, your obedient servant,

W. P. CRAIGHILL,
Brig. Gen., Chief of Engineers.

HON. DANIEL S. LAMONT,
Secretary of War.

REPORT OF MAJ. H. M. ADAMS, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
New York City, January 8, 1897.

GENERAL: I have the honor to submit the following report upon a preliminary examination of Lloyds Harbor, with a view to its connection with Cold Spring Bay, New York, made in compliance with the provisions of the river and harbor act of June 3, 1896:

Lloyds Harbor is a shallow inlet 2½ miles long and from one-eighth to one-half mile wide, extending westwardly from Huntington Bay, on the north shore of Long Island, 40 miles by water from the Battery, New York City, and separated from Cold Spring Bay on the west by Lloyds Beach, a low beach from 100 to 200 feet wide at high tide.

The improvement desired is the cutting of a channel through Lloyds

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Beach and deepening the channel of Lloyds Harbor so as to connect deep water in Huntington Bay with deep water in Cold Spring Bay by an inland channel, in order to avoid the exposed passage around Lloyds Neck. The commerce which would use such a channel is that between the villages of Huntington and Northport, Long Island, and New York City, and the westward freights of gravel from Godfreys Beach, on the east shore of Huntington Bay.

This commerce amounts to, as nearly as can be ascertained, the following:

	Tons.	Value.
Northport	55,000	$1,400,000
Huntington	70,000	1,100,000
Godfreys Beach	116,000	100,000
Total	241,000	2,600,000

Approximately one-half this commerce is carried in sail vessels and one-half in steamers or vessels in tow. One steamboat makes regular trips between New York City and Huntington, and another between New York City and Northport; these vessels would probably always use a channel through Cold Spring Bay and Lloyds Harbor, which would somewhat shorten their trips; sailing vessels would use it only when the wind was fair.

It is claimed that the large steamers of the Long Island Sound lines, which sometimes come into Huntington Bay for shelter when the weather is very rough, would come in by way of Lloyds Harbor and Cold Spring Bay if the channel were opened, avoiding, in east-bound trips, the rough passage around Lloyds Neck. Such use of the channel is not probable, however. If these large boats once came into the entrance of Cold Spring Bay they would find sufficient shelter there without passing on to Huntington Bay. A channel for this purpose would necessarily have to be larger and deeper than one for local commerce.

Lloyds Neck, the peninsula between Cold Spring and Huntington bays, is 2 miles north and south by 3 miles east and west, and is almost wholly separated from the main part of Long Island by Lloyds Harbor, the only communication being by a highway across Lloyds Beach. If this were cut through it would be necessary to provide a drawbridge across the channel at some convenient point. And it is probable that the entrance to the cut from Cold Spring Bay, which would be exposed to northwesterly winds, would require some breakwater protection to prevent shoaling.

A survey of this locality, with a view to connecting Cold Spring Bay and Lloyds Harbor, was made under authority of the river and harbor act of 1880, the report upon which was printed in the Annual Report of the Chief of Engineers for 1881, page 613. This report estimated the cost of the dredging which would be necessary for a channel 200 feet wide and 10 feet deep at mean low water as $209,940. It is possible that the work could be done at the present time at slightly lower rate, but liberal allowance would have to be made for expense of maintenance.

In view, therefore, of the great cost of this work, as compared with the benefit which a not very large amount of commerce would receive, I am of the opinion that the connection of Lloyds Harbor with Cold

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Spring Bay, New York, by a navigable channel is not an improvement worthy to be undertaken by the United States.

Very respectfully, your obedient servant,

H. M. ADAMS,
Major, Corps of Engineers.

Brig. Gen. W. P. CRAIGHILL,
Chief of Engineers, U. S. A.
(Through the Division Engineer.)

[First indorsement.]

NORTHEAST DIVISION ENGINEER OFFICE,
Washington, January 11, 1897.

Respectfully forwarded to the Chief of Engineers.

For the reasons stated by the local engineer, I concur in his views that the connection of Lloyds Harbor with Cold Spring Bay, New York, by a navigable channel is not an improvement worthy to be undertaken by the United States.

JOHN M. WILSON,
Colonel, Corps of Engineers,
Division Engineer, Northeast Division.

F 31.

PRELIMINARY EXAMINATION OF NORTHPORT HARBOR, NEW YORK.

[Printed in House Doc. No. 90, Fifty-fourth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 3, 1896.

SIR: I have the honor to submit the accompanying copy of report of November 10, 1896, by Maj. H. M. Adams, Corps of Engineers, upon preliminary examination of Northport Harbor, New York, made to comply with the terms of the river and harbor act of June 3, 1896.

In the opinion of Major Adams, and of Col. John M. Wilson, Corps of Engineers, the Division Engineer, Northport Harbor is worthy of improvement by the United States to the extent of deepening the channel along the village water front to make it from 9 to 10 or perhaps 12 feet deep and 100 feet wide for a distance estimated at 2,000 feet.

I concur in this opinion in so far as to advise the making of a survey of the harbor, estimated to cost $250, upon the results of which a more reliable opinion can be formed as to the extent of the improvement justified by the commerce involved.

Very respectfully, your obedient servant,

W. P. CRAIGHILL,
Brig. Gen., Chief of Engineers.

Hon. DANIEL S. LAMONT,
Secretary of War.

REPORT OF MAJ. H. M. ADAMS, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
New York City, November 10, 1896.

GENERAL: I have the honor to submit the following report upon the preliminary examination of Northport Harbor, New York, made in pursuance of the provisions of the river and harbor act of 1896:

Northport is an incorporated village of about 2,000 inhabitants, on

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the east shore and near the head of Northport Harbor. The harbor opens to the eastward from Huntington Bay, 42 miles by water from the Battery, New York City. It is 4 miles long and from half a mile to more than a mile broad, rather crooked, and completely landlocked. The channel is about 300 feet wide at the entrance, and wider inside, covering nearly the whole harbor basin. It has sufficient depths—from 10 to 20 feet—up to the lower wharves of the village, where it shoals to 7 feet, and farther up to 6 feet at mean low water. The mean rise of tide is about 7 feet.

The commerce of Northport Harbor during the year 1895 amounted to about 55,000 tons, estimated at $1,400,000 value. It consists principally of coal, building materials, oysters, books, electrotypes, farm produce, and cord wood. This traffic is carried on by one steamer, 6½ feet draft, 125 tons capacity, making daily round trips between Northport and New York City during summer, and three round trips per week during winter; by seven oyster steamers of 6 to 7 feet draft, running in and out the harbor daily or oftener; by several schooners of 5 to 12 feet draft, and barges of about 7 feet draft, making occasional trips. The boats of deepest draft are lumber schooners from Maine. They can not reach the wharves without lightering. The regular steamers can not reach their landings at low tide, and in extreme low tides are frequently delayed two or three hours at a time.

Northport has two shipyards where vessels are repaired and built.

The improvement desired is the deepening of the channel along the village water front to make it from 9 to 10 or perhaps 12 feet deep and 100 feet wide for a distance estimated at 2,000 feet.

In my opinion, Northport Harbor is worthy of improvement by the United States for the reasons and to the extent indicated. A survey would be necessary to determine the best course for the dredged channel, its extent, and a fair estimate of its cost. The expense of such a survey would be $250.

Very respectfully, your obedient servant,

H. M. ADAMS,
Major, Corps of Engineers.

Brig. Gen. W. P. CRAIGHILL,
Chief of Engineers, U. S. A.

(Through the Division Engineer.)

[First indorsement.]

NORTHEAST DIVISION ENGINEER OFFICE,
Washington, November 17, 1896.

Respectfully forwarded to the Chief of Engineers, concurring in the views of the local engineer.

JOHN M. WILSON,
Colonel, Corps of Engineers,
Division Engineer, Northeast Division.

F 32.

PRELIMINARY EXAMINATION OF SMITHTOWN HARBOR, NEW YORK.

[Printed in House Doc. No. 128, Fifty-fourth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 18, 1896.

SIR: I have the honor to submit the accompanying copy of report, of December 15, 1896, by Maj. H. M. Adams, Corps of Engineers, of

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the results of a preliminary examination of Smithtown Harbor, New York, made in compliance with the requirements of the river and harbor act of June 3, 1896.

It is the opinion of Major Adams that the improvement of this locality is not worthy to be undertaken by the United States, and his views are concurred in by Col. John M. Wilson, Corps of Engineers, Division Engineer. and by me.

Very respectfully, your obedient servant,

W. P. CRAIGHILL,
Brig. Gen., Chief of Engineers.

Hon. DANIEL S. LAMONT,
Secretary of War.

REPORT OF MAJ. H. M. ADAMS, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
New York City, December 15, 1896.

GENERAL: I have the honor to submit the following report upon the preliminary examination of Smithtown Harbor, New York, made under provision of the river and harbor act of 1896.

Smithtown Harbor is on the north shore of Long Island, 50 miles by water from the Battery, New York City. The harbor consists of the entrance to the Nissequogue River and of the lower or tidal part of the river for about 3 miles above its mouth. The general course of the stream is northwesterly, changing to westerly, and running nearly parallel with Long Island Sound for a quarter of a mile, being separated from the Sound by a low sand beach. At the west end of the sand beach the channel turns northward and crosses a broad, shallow bar, about a foot deep at low tide, before reaching deep water. This outer bar is three-quarters of a mile from the main shore, and its exposed situation makes the shallow entrance channel very difficult to navigate in rough weather. The mean rise of tide is about 7 feet.

Smithtown is a small and scattered community, mostly engaged in farming. The Long Island State Hospital for the Insane is located near the west shore of Smithtown Harbor, and near the Kings Park Station of the Long Island Railroad. It has about 900 acres of land, with several large buildings, and is said to have now about 1,450 inmates and 250 attendants, a population of 1,700. A short distance west from the harbor entrance is located an institution for the care of aged and infirm persons and orphans, called St. Johnland, which has from 150 to 200 inmates. The State of New York has dredged a channel extending from near the entrance of the harbor to the hospital grounds, at the upper end of which channel it has nearly completed a coal hoist, storage bins, and dock. The channel is half a mile long, 7 feet deep at low tide, and 45 to 50 feet wide at the bottom; it follows the general course of a small tidal creek in the salt marsh.

There is a wharf at the mouth of the Nissequogue River belonging to the town of Smithtown, another near the mouth, owned or controlled by the State hospital, and two landings farther up the stream.

The commerce of Smithtown Harbor consists of manure and fertilizers, coal, and building materials, and miscellaneous supplies received, and of posts and cord wood shipped. During the past year this commerce is estimated to have been 4,650 tons, roughly valued at $30,000, exclusive of the coal received for the State hospital. The amount of

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the latter brought by water has not yet been reported. The entire coal supply is 10,000 tons per year, and it is expected that the whole will be brought by water when the coal hoists are finished.

This traffic is carried on by sloops of 50 to 100 tons capacity and of 5 to 6 feet draft. A small propeller of 50 tons capacity and 7 feet draft has made occasional trips to the State hospital.

The improvement desired is the construction of a breakwater on the east side of the entrance channel, to extend from the east beach out to and across the outer bar, so as to protect the entrance and make it possible to dredge and maintain a channel 6 to 7 feet deep from Long Island Sound into the harbor or creek. No dredging is asked for at present, because it is said that the State of New York would probably dredge a sufficient channel up to the hospital dock if the breakwater were built.

The desired breakwater would be about a mile long and would lie on bottom from 1 foot above to 6 or perhaps 8 feet below low water. It would be most economically built of riprap. On account of the exposed location such a work would require a substantial cross section and the use of comparatively large stones. It is not improbable that a west breakwater would also be found necessary to protect a dredged channel through the extensive sand shoals.

In my opinion, the present and prospective commerce of Smithtown Harbor is not such as to warrant the expenditure necessary for a useful improvement of the harbor entrance, and I therefore consider that the desired improvement of Smithtown Harbor is not a work worthy to be undertaken by the United States.

Very respectfully, your obedient servant,

H. M. ADAMS,
Major, Corps of Engineers.

Brig. Gen. W. P. CRAIGHILL,
Chief of Engineers, U. S. A.
(Through the Division Engineer.)

[First indorsement.]

NORTHEAST DIVISION ENGINEER OFFICE,
Washington, December 16, 1896.

Respectfully forwarded to the Chief of Engineers.

For the reasons given herein by the local engineer, Maj. Henry M. Adams, I concur in his opinion that the desired improvement of Smithtown Harbor is not a work worthy to be undertaken by the General Government.

JOHN M. WILSON,
Colonel, Corps of Engineers,
Division Engineer, Northeast Division.

F 33.

PRELIMINARY EXAMINATION OF CHANNELS TO FAR ROCKAWAY AND INWOOD, NEW YORK.

[Printed in House Doc. No. 216, Fifty-fourth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., January 22, 1897.

SIR: I have the honor to submit the accompanying copy of report of January 18, 1897, by Maj. H. M. Adams, Corps of Engineers, of the

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results of a preliminary examination of "channels to Far Rockaway and Inwood," made in compliance with requirements of the river and harbor act of June 3, 1896.

Major Adams states that in view of the small amount of commerce as compared with the expense of making and maintaining such a channel as is desired, this work appears to be a matter of local convenience rather than of public importance, and he is therefore of opinion that this improvement is not worthy of being undertaken by the United States.

His views are concurred in by Col. John M. Wilson, Corps of Engineers, the division engineer, and by me.

Very respectfully, your obedient servant,

W. P. CRAIGHILL,
Brig. Gen., Chief of Engineers.

Hon. DANIEL S. LAMONT,
Secretary of War.

REPORT OF MAJ. H. M. ADAMS, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
New York City, January 18, 1897.

GENERAL: I have the honor to submit the following report upon the preliminary examination of the channels to Far Rockaway and Inwood, N. Y., made in compliance with the provisions of the river and harbor act of 1896.

Far Rockaway and Inwood are adjoining villages at the east end of Jamaica Bay. A small tidal inlet extending eastward from the bay partly separates the villages, and it is upon the shores of this inlet that the wharves of both places are located and practically all the water traffic of both places is conducted; the channels to Far Rockaway and Inwood are therefore one and the same channel, so far as the main channel is concerned, only diverging as they turn off to the separate wharves. The natural depth in this channel averages about 2 feet at mean low water, and the distance from the upper wharves to the 6-foot depth in "Grass Hassock Channel," Jamaica Bay, is about a mile. The mean rise of tide is 4.4 feet.

Far Rockaway is a suburban village of about 3,000 permanent inhabitants. It has no local industries other than supplying the needs of this population and of the large number of summer visitors, estimated at 12,000. Inwood is a much smaller community, the people of which are largely interested in oyster growing. Immediately north of Inwood is the village of Lawrence, which receives coal, etc., via Inwood landings. The population of Inwood and Lawrence together is estimated at 2,500.

The amount of freights received and shipped by water in the channels to Far Rockaway and Inwood during the past year is estimated as follows:

	Tons.	Estimated value.
Coal	20,000	$100,000
Brick	12,000	42,000
Gravel for roads	10,000	10,000
Oysters, probably	10,000	250,000
Total	52,000	402,000

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In addition, there were 10,000 tons of coal and about 3,000 tons of lumber brought by rail, which it is said would be brought by water if the channel were better.

These freights are carried in small vessels of 20 to 80 tons capacity and of 4 to 6 feet draft. There are nine such vessels engaged in regular freighting, exclusive of the oyster boats. These boats were built for and are adapted to the existing conditions of channel, and the owners of them, in some cases at least, depend for livelihood on what they earn in this freighting. Six feet is the greatest draft which can be brought up to the vicinity of the wharves at high tide.

The improvement desired is the dredging of the channel to make it 5 or 6 feet deep at low tide and about 100 feet wide to a point opposite the upper wharves, which are the public wharves of Inwood, at Tones Island, so that coal and other heavy freights can be brought in the ordinary light-draft canal boats and barges, which require 8 feet of water.

In view of the small amount of commerce as compared with the expense of making and maintaining such a channel as is desired, this work appears to be a matter of local convenience rather than of public importance, and therefore, for the reasons stated, I am of the opinion that the improvement of the channels to Far Rockaway and Inwood is not a work worthy to be undertaken by the United States.

Very respectfully, your obedient servant,

H. M. ADAMS,
Major, Corps of Engineers.

Brig. Gen. W. P. CRAIGHILL,
Chief of Engineers, U. S. A.
(Through the Division Engineer.)

[First indorsement.]

NORTHEAST DIVISION ENGINEER OFFICE,
Washington, January 19, 1897.

Respectfully forwarded to the Chief of Engineers.

For the reasons given by the district engineer, I concur in his opinion that the improvement of the channels to Far Rockaway and Inwood is a work not worthy to be undertaken by the United States.

JOHN M. WILSON,
Colonel, Corps of Engineers,
Division Engineer, Northeast Division.

F 34.

PRELIMINARY EXAMINATION OF BABYLON CREEK, NEW YORK.

[Printed in House Doc. No. 222, Fifty-fourth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., January 25, 1897.

SIR: I have the honor to submit the accompanying copy of report of January 20, 1897, by Maj. H. M. Adams, Corps of Engineers, of the results of a preliminary examination of Babylon Creek, New York, made in compliance with requirements of the river and harbor act of June 3, 1896.

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Major Adams states that Babylon Creek is the same stream which, under title of Sumpawanus Inlet, was surveyed in 1880 and partly deepened, under appropriations made by Congress in 1881 and 1882, to 5 feet for a width of 75 feet.

He is of opinion, in view of the small amount of commerce by water at present, and the relatively large cost of making and maintaining such a channel as is desired, that the improvement of Babylon Creek, New York, is not a work worthy to be undertaken by the United States.

His views are concurred in by the division engineer, Col. John M. Wilson, Corps of Engineers, and by me.

Very respectfully, your obedient servant,

A. MACKENZIE,
Acting Chief of Engineers.

Hon. DANIEL S. LAMONT,
Secretary of War.

REPORT OF MAJ. H. M. ADAMS, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
New York City, January 20, 1897.

GENERAL: I have the honor to submit the following report upon a preliminary examination of Babylon Creek, New York, made in compliance with the provisions of the river and harbor act of 1896.

Babylon Creek is a tidal stream, with a small fresh-water discharge emptying into Great South Bay, on the south shore of Long Island at a point nearly opposite Fire Island Inlet and 35 miles east from New York Harbor. Great South Bay at this point is about 6 miles wide, but by course of channel the distance across to Fire Island Inlet is nearly 11 miles. The available depth in the channel up to a point off the mouth of Babylon Creek is 7 feet or over at low tide. Near the mouth of the creek is a landing owned by the State of New York, and adjoining and just above it is a small town dock. The depth to these landings is said to be 4½ feet at low tide, while the depth in the creek for about three-quarters of a mile to the upper landings ranges from 1 to 2 feet. The mean rise of tide at the State dock is 1.3 feet.

The village of Babylon lies on the west side of Babylon Creek. It is chiefly known as a summer resort, having a permanent population of 3,000, which is increased to three or four times that number in summer. In Babylon there are no manufactures or other industries which would require considerable amounts of coal or raw materials, and the building up of such industries is not encouraged, because it would be detrimental to the distinctive character of the locality as a summer resort. The only business carried on is the furnishing of supplies required by the residents of the village and immediately adjoining country.

The amount of freight received by water during the past year is estimated as follows:

	Tons.
Coal	1,500
Brick	500
Salt hay	500
Feed	500
Total	3,000

All of the lumber used and the miscellaneous freights are brought by rail, as well as the greater part of the coal, brick, and feed, and it is

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claimed that 15,000 tons of this freight would be brought by water instead if the channel facilities were better.

In the summer small steamboats make frequent trips from the State dock to Oak Island and Fire Island Beach, across the bay, carrying passengers and supplies.

Brick and coal are now brought in schooners of about 6 feet draft, which anchor near the lower docks. Sometimes the cargoes are discharged at the town dock near by, but generally they are lightered to the small private docks in the upper part of the stream.

Babylon Creek is the same stream which, under the title of Sumpawanus Inlet, was surveyed in 1880 and partly deepened under appropriations made by Congress in 1881 and 1882, aggregating $7,000. The plan for that improvement contemplated dredging a channel 150 feet wide and 5 feet deep at mean low water up to the steamboat dock—now the State dock—and thence 100 feet wide and 5 feet deep up to the small private docks at the village, a farther distance of about 3,500 feet, at a total estimated cost of $23,115. Under the above-mentioned appropriations the channel from the State dock out 750 feet toward deep water was made 75 feet wide and 5 feet deep in 1883; in 1886 the depth had shoaled to 4 and 4½ feet. No appropriation for the work has been made since 1882.

The improvement now desired is similar to that proposed in 1880 and abandoned since 1883, except that the depth now wanted is 6 feet, and a width of 80 feet is considered sufficient for the upper part of the creek. These changes would somewhat increase the cost of making the channel, and would materially increase the cost of maintaining it.

In his annual report for 1888 (Annual Report of the Chief of Engineers for 1888, p. 631) the officer in charge of the improvement of Sumpawanus Inlet stated:

"So far as the extension of the improvement from the steamboat dock up to the inlet is concerned, there appears to be no reason why the Government of the United States should undertake it," and "ten thousand dollars can be expended in giving a five-foot channel out into the bay for the use of steamboats, but I think that the work is more a matter of local than of public interest."

This statement was repeated in several subsequent reports, and is equally pertinent to-day. In view of the small amount of commerce by water at present and the relatively large cost of making and maintaining such a channel as is desired, I am of opinion that the improvement of Babylon Creek, New York, is not a work worthy to be undertaken by the United States.

Very respectfully, your obedient servant,

H. M. ADAMS,
Major, Corps of Engineers.

Brig. Gen. W. P. CRAIGHILL,
Chief of Engineers, U. S. A.
(Through the Division Engineer.)

[First indorsement.]

NORTHEAST DIVISION ENGINEER OFFICE,
Washington, January 21, 1897.

Respectfully forwarded to the Chief of Engineers.

For the reasons given by the local engineer I concur in his opinion that the improvement of Babylon Creek, New York, is not a work worthy to be undertaken by the United States.

JOHN M. WILSON,
Colonel, Corps of Engineers,
Division Engineer, Northeast Division.

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F 35.

SURVEY OF EAST CHESTER CREEK, NEW YORK, WITH A VIEW TO EXTENDING IMPROVEMENT TO HEAD OF TIDE WATER.

[Printed in House Doc. No. 147, Fifty-fourth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 24, 1896.

SIR: I have the honor to submit the accompanying copy of report, dated December 19, 1896, by Maj. H. M. Adams, Corps of Engineers, upon the results of a survey of East Chester Creek, New York, with a view to extending improvement to head of tide water, made to comply with provisions of the river and harbor act of June 3, 1896.

The plan presented in the report provides for extending the present improvement to the crossing of the old post road by means of an artificial channel through private lands, 100 feet wide at bottom and 9 feet deep at mean high water, estimated cost as follows:

Dredging and depositing 85,000 cubic yards of mud and marsh sod, at 18 cents per yard	$15,300
Dredging and depositing 35,000 cubic yards of sand and gravel, at 27 cents per yard	9,450
Contingencies, about 10 per cent	2,250
Total	27,000

This estimate makes no provision for cost of obtaining right of way through private lands and contemplates deposit of dredgings upon such lands.

For reasons given, Major Adams is of the opinion, which is concurred in by Col. John M. Wilson, Corps of Engineers, the division engineer, and by me, that the proposed improvement is not worthy of being undertaken by the United States.

Very respectfully, your obedient servant,

W. P. CRAIGHILL,
Brig. Gen., Chief of Engineers.

Hon. DANIEL S. LAMONT,
Secretary of War.

LETTER OF MAJ. H. M. ADAMS, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
New York City, December 19, 1896.

GENERAL: I have the honor to transmit herewith in duplicate my report upon the survey of "East Chester Creek, New York, with a view to extending improvement to head of tide water," provided for by the river and harbor act of June 3, 1896.

In my opinion the proposed improvement is not worthy to be undertaken by the United States. There is no commerce whatever in this part of East Chester Creek, and no prospective commerce which, in my opinion, would justify any extension of the present improvement.

Very respectfully, your obedient servant,

H. M. ADAMS,
Major, Corps of Engineers.

Brig. Gen. W. P. CRAIGHILL,
Chief of Engineers, U. S. A.
(Through the Division Engineer.)

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[First indorsement.]

NORTHEAST DIVISION ENGINEER OFFICE,
Washington, December 21, 1896.

Respectfully forwarded to the Chief of Engineers, concurring in the views of the local engineer.

JOHN M. WILSON,
Colonel, Corps of Engineers,
Division Engineer, Northeast Division.

REPORT OF MAJ. H. M. ADAMS, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
New York City, December 19, 1896.

GENERAL: I have the honor to submit the following report upon a survey of East Chester Creek, New York, with a view to extending the improvement to the head of tide water, as provided in the river and harbor act of 1896, together with a map * of the survey.

East Chester Creek is a tidal stream with low marshy banks, extending inland from Pelham Bay, on the north shore of Long Island Sound, 20 miles by water from the Battery, New York City. In its natural condition the stream was navigated to some extent as far up as Lockwoods, about 2¼ miles above its mouth. Although the bed of the creek ran nearly bare at low tide, the rise of tide, amounting to 7.1 feet, made navigation possible at high water.

In 1873 a project for improvement was adopted which contemplated straightening the course of the creek and making a channel 100 feet wide and 9 feet deep at mean high water to a point 3,000 feet above Lockwoods. The channel has been extended to the limit mentioned and the project is nearly completed, some points below Lockwoods not yet having the full projected depth and width. This channel is the only water route to the city of Mount Vernon, a city of about 20,000 population, on the north boundary of New York City. The lower half of the water front along the 3,000 feet above Lockwoods and on the west side of the channel has been docked, and in 1895 94,928 tons of freight were reported as handled on the creek, mostly at that point.

The object of the survey is to obtain an estimate of the cost of extending the improvement to the head of tide water, which is virtually to the crossing of the old post road, 6,000 feet above Lockwoods and 3,000 feet above the upper limit of the present dredged channel. Extreme high tides extend up the bed of the stream one-fourth mile farther, but above the post road the creek at half tide is only a narrow fresh-water drain.

In this part of East Chester Creek there is no navigation now, nor is it now susceptible of navigation. The stream is very crooked, having a length of 5,400 feet in the 3,000 feet between the upper end of the present improvement and the post road. Some of the bends are so sharp that a boat of 50 feet length could not pass them. The stream ranges in width from 12 to 40 feet, averaging about 20 feet, and the bottom is generally above mean low-water level. Any improvement of this part of East Chester Creek for purposes of navigation would necessitate abandoning the bed of the stream and making an artificial canal through

* Not printed.

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private lands. An extension of the improvement of this stream to the post road would carry water communication somewhat nearer the eastern part of the city of Mount Vernon and the villages of Pelham Manor and Pelham. The navigation which would be benefited by such a channel is wholly prospective, and its amount is a matter of mere conjecture.

As any extension of the present improvement would be an artificial channel, the important condition to be observed in the layout would be the avoiding of rocks. A layout as suitable as any for such a channel is indicated on the map. The cost of extending the present improvement to the post road as an artificial channel 100 feet wide at the bottom and 9 feet deep at mean high water is estimated as follows:

Dredging and depositing 85,000 cubic yards of mud and marsh sod, at 18 cents per yard	$15,300
Dredging and depositing 35,000 cubic yards of sand and gravel, at 27 cents per yard	9,450
Contingencies, about 10 per cent	2,250
Total	27,000

This estimate makes no provision for cost of obtaining right of way through private lands and contemplates deposit of dredgings upon such lands.

Very respectfully, your obedient servant,

H. M. ADAMS,
Major, Corps of Engineers.

Brig. Gen. W. P. CRAIGHILL,
Chief of Engineers, U. S. A.

F 36.

SURVEY OF BAY RIDGE CHANNEL, THE TRIANGULAR AREA BETWEEN BAY RIDGE AND RED HOOK CHANNELS AND RED HOOK AND BUTTERMILK CHANNELS, NEW YORK HARBOR, WITH A VIEW TO MAKING ONE CONTINUOUS CHANNEL WITH A LEAST DEPTH OF 30 FEET AT MEAN LOW WATER FOR A WIDTH OF 1,000 FEET, AND ALSO FOR A CONTINUOUS CHANNEL WITH A LEAST DEPTH OF 35 FEET AT MEAN LOW WATER FOR A WIDTH OF 1,200 FEET.

[Printed in House Doc. No. 337, Fifty-fourth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., March 1, 1897.

SIR: I have the honor to submit the accompanying report, dated February 24, 1897, with map,* by Maj. H. M. Adams, Corps of Engineers, giving the results of a survey of "Bay Ridge Channel, the triangular area between Bay Ridge and Red Hook channels, and Red Hook and Buttermilk channels, with a view to making one continuous channel with a least depth of thirty feet at mean low water for a width of one thousand feet, and also for a continuous channel with a least depth of thirty-five feet at mean low water for a width of one thousand two hundred feet," provided for by the river and harbor act of June 3, 1896.

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* Not reprinted. Printed in House Doc. No. 337, Fifty-fourth Congress, second session.

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The locality in question is at present being improved, and, under the provisions of the same act which authorized this survey, a continuing contract has been made for dredging these channels to a depth of 26 feet at mean low water and widths varying from 400 feet to 1,000 feet.

In addition to the work already done and provided for, Major Adams estimates that the cost of securing the channel 30 feet deep at mean low water and 1,000 feet wide, as specified by the act of June 3, 1896, will be $2,000,000; of securing the channel 35 feet deep at mean low water and 1,200 feet wide, $5,300,000.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. DANIEL S. LAMONT,
Secretary of War.

REPORT OF MAJ. H. M. ADAMS, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
New York City, February 24, 1897.

GENERAL: I have the honor to submit the following report upon a survey of "Bay Ridge Channel, the triangular area between Bay Ridge and Red Hook channels, and Red Hook and Buttermilk channels, with a view to making one continuous channel with a least depth of 30 feet at mean low water for a width of 1,000 feet, and also for a continuous channel with a least depth of 35 feet at mean low water for a width of 1,200 feet," made under the provisions of the river and harbor act of 1896, together with a map of the survey.

Bay Ridge Channel and the other channels in the order named form an eastern water route between the Narrows and the East River, New York Harbor, skirting close along the water front of South Brooklyn and Brooklyn, passing east of Governors Island and reaching the curve of 35 feet depth in the East River at a point 5¾ miles from the 35-foot contours at the south end of Bay Ridge Channel. The natural depths in Bay Ridge and Red Hook channels were from 7 to 12 feet; through Buttermilk Channel there was a natural depth of 26 feet, but the course of the channel way was crooked and, on account of the rapid current, very difficult to follow.

In 1880 a project was adopted for removing part of a shoal at the north end of Buttermilk Channel to a depth of 26 feet at mean low water. Under authority of several subsequent acts of Congress this project has been extended until it now includes making a depth of 26 feet at mean low water throughout the whole of this eastern water route, with widths as follows:

	Feet.
For Bay Ridge Channel, a width of	800
For the triangular area between Bay Ridge and Red Hook channels, a maximum width of	900
For Red Hook Channel, a width of	400
For Buttermilk Channel, a width of	1,000

Under the terms of the river and harbor act of 1896 a contract has been entered into for completing the entire channel as projected, and the work is in progress.

The object of the present survey is to obtain an estimate of the cost of deepening and widening these channels, first, to a depth of 30 feet at

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mean low water with 1,000 feet width, and second, to a depth of 35 feet at mean low water with 1,200 feet width. So far as the previous dredging to 26 feet depth indicates, the material to be excavated in making such channels is, in Bay Ridge Channel, mud and sand at the lower end and sand overlaid with mud at the upper end; in the triangular area and in Red Hook Channel, mainly sand; in Buttermilk Channel, hard sand and gravel, containing some bowlders. On account of the narrowness of part of Buttermilk Channel (the minimum distance between the Governors Island sea wall and the established pier line opposite being 1,310 feet) it would be inexpedient to make a depth of 35 feet with the full width of 1,200 feet, and therefore the estimates contemplate a width of 1,100 feet only at this point.

The estimated cost of making the channels under consideration, in addition to the work already done and provided for under the existing project and contract, is as follows:

For a channel 30 feet deep at mean low water and 1,000 feet wide:	
Dredging Bay Ridge and Red Hook channels, and the triangular area between them, 6,900,000 cubic yards of sand and mud, at 18 cents per cubic yard	$1,242,000
Dredging Buttermilk Channel, 1,900,000 cubic yards of sand and gravel, containing bowlders, at 30 cents per cubic yard	570,000
Contingencies, supervision, etc., about 10 per cent	188,000
Total estimated cost	2,000,000
For a channel 35 feet deep at mean low water and 1,200 feet wide:	
Dredging Bay Ridge and Red Hook channels and the triangular area between them, 16,800,000 cubic yards of sand and mud, at 20 cents per cubic yard	3,360,000
Dredging Buttermilk Channel, 4,230,000 cubic yards of sand and gravel, containing bowlders, at 35 cents per cubic yard	1,480,500
Contingencies, supervision, etc., about 10 per cent	459,500
Total estimated cost	5,300,000

The benefit to navigation which would result from such channels as are contemplated in this survey would be the development of commerce along Bay Ridge Channel and the affording of increased facilities to the commerce of Buttermilk Channel and to the Erie Basin entrance.

The commerce of Bay Ridge Channel would be benefited by the entire improvement, which would afford a very wide and deep channel both from the Narrows and from the upper harbor and extending along a water front which is as yet but partly developed. The total commerce at the docks along Bay Ridge Channel in the calendar year 1896 is reported as 717,999 tons, valued at $12,045,270. The depth in this channel is now 26 feet at low water; two of the docks have a depth at the end, or alongside, of 18 feet at low water, and the others generally from 6 to 12 feet.

There is no commerce in the triangular area between Bay Ridge and Red Hook channels, except such as is in transit between the two channels.

The commerce of Red Hook Channel during 1896 is reported as 833,356 tons. About 3,000 tons of this is actually discharged at the docks. The rest consists of coal in barges of 6 to 9 feet draft, which are brought into these waters, assembled into tows, and taken away again.

The commerce of Buttermilk Channel, from the Erie Basin to Atlantic avenue, Brooklyn, during 1896 is reported as 15,080,318 tons, valued at $302,606,360. It is carried in vessels from 18 to 28 feet draft. Besides

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this, the commerce from Atlantic avenue to Fulton street, Brooklyn, would find its shortest outlet by Buttermilk Channel. This is reported as amounting to 8,566,738 tons.

The present depths along the ends of the piers in Buttermilk Channel are from 20 to 35 feet.

Very respectfully, your obedient servant,

H. M. ADAMS,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

F 37.

SURVEY OF GOWANUS CREEK, NEW YORK, WITH A VIEW OF OBTAINING A DEPTH OF 30 FEET AT MEAN LOW WATER.

[Printed in House Doc. No. 336, Fifty-fourth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., March 1, 1897.

SIR: I have the honor to submit the accompanying report of February 24, 1897, by Maj. H. M. Adams, Corps of Engineers, of the results of a survey of Gowanus Creek, New York, with a view to obtaining a depth of 30 feet at mean low water, made to comply with the requirements of the river and harbor act of June 3, 1896.

A map of this survey was made on one sheet with contiguous surveys and accompanies a report* by Major Adams on survey of Bay Ridge Channel, etc., submitted to the Secretary to-day.

Work is now being carried on at this locality under a project which provides for improving Gowanus Creek Channel by deepening it to 26 feet at mean low water from the foot of Percival street to its junction with the Red Hook Channel, and Major Adams estimates the cost of making this channel 30 feet deep at mean low water between the harbor lines to be $58,000 in addition to the cost of completing the project for 26 feet depth.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. DANIEL S. LAMONT,
Secretary of War.

REPORT OF MAJ. H. M. ADAMS, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
New York City, February 24, 1897.

GENERAL: I have the honor to submit the following report upon the survey of Gowanus Creek, New York Harbor, "with a view of obtaining a depth of 30 feet at mean lower water," made under the provisions of the river and harbor act of 1896.

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* Printed in House Doc. No. 337, Fifty-fourth Congress, second session.

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Gowanus Creek was originally a tidal inlet in the southern part of the city of Brooklyn, emptying into Gowanus Bay. For purposes of improvement the Gowanus Creek Channel has been defined as extending from the junction of Bay Ridge and Red Hook channels, opposite Henry street, Brooklyn, and Twenty-eighth street, South Brooklyn, northeastwardly to the foot of Percival street, a distance of about 3,000 feet, that part of the stream northeast of Percival street being called Gowanus Canal. This designation, originally arbitrary, has been referred to in the several recent annual reports upon improvements of the Gowanus Bay channels, and has been adopted by Congress in defining the limits of appropriations for improvements in that locality.

In 1881 a project was adopted for improving the channels of Gowanus Bay, which provided for a depth of 18 feet at mean low water, with 200 feet width in Gowanus Creek. This project was subsequently extended to increase the depth to 21 feet, which depth was obtained in 1891 with a width of 100 feet, and in 1894 with the full width between the harbor lines. Of the sums appropriated for the Gowanus Bay channels, about $75,000 was applied to the improvement of Gowanus Creek.

The river and harbor act of 1896 appropriated $25,000 for improving Gowanus Creek Channel "by deepening the same to twenty-six feet at mean low water from the foot of Percival street to its junction with the Red Hook Channel," and the project was accordingly extended to provide for the specified depth of 26 feet between the harbor lines, a width varying from 250 to 350 feet, the total estimated cost of which is $70,000.

The estimated cost of making this channel 30 feet deep at mean low water between the harbor lines is as follows, in addition to the cost of completing the project for 26 feet depth:

Dredging, mainly sand and gravel, 210,000 cubic yards, scow measurement, at 25 cents	$52,500
Contingencies, supervision, etc., about 10 per cent	5,500
Total	58,000

The amount of commerce along Gowanus Creek and Gowanus Canal below Hamilton Avenue Bridge for the calendar year 1896 is reported as 2,164,654 tons. At least nine-tenths of this freight is carried in boats of less than 12 feet draft. There are two piers at the entrance to Gowanus Creek which have available depths of about 20 feet at low tide, and three others farther up which have depths of from 16 to 18 feet. With these exceptions the depth alongside the docks does not exceed 12 feet at mean low water. The channel had been made 21 feet deep and 100 feet wide in 1891 and was further widened out to the harbor lines with the same depth in 1894. Under the project adopted in 1896 it is to be made 26 feet deep.

Very respectfully, your obedient servant,

H. M. ADAMS,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

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F 38.

SURVEY OF CHANNEL BETWEEN THE BATTERY AND GOVERNORS ISLAND, NEW YORK, WITH A VIEW TO MAKING A CHANNEL CONTINUOUS WITH BUTTERMILK CHANNEL 30 FEET IN DEPTH AND 1,200 FEET IN WIDTH.

[Printed in House Doc. No. 334, Fifty-fourth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., March 1, 1897.

SIR: I have the honor to submit the accompanying report, dated February 24, 1897, by Maj. H. M. Adams, Corps of Engineers, giving the results of a survey of the channel between the Battery and Governors Island, New York Harbor, with a view to making a channel continuous with Buttermilk Channel 30 feet in depth and 1,200 feet in width, made to comply with the provisions of the river and harbor act of June 3, 1896.

Major Adams states that the least expensive method of securing for this channel the width and depth contemplated in the act would involve dredging along the northeast shore of Governors Island and removing part of Dimond Reef, at a total estimated cost of about $500,000, but that this plan would afford an increased depth over only that part of the channel which is least used and would leave the ragged edge of Dimond Reef a very serious source of danger. He further states that when the improvement of this channel is undertaken the work should include all that is necessary or practicable to relieve the crowded condition of the locality and make it accessible from East River and the upper end of Buttermilk Channel; that Dimond Reef and Coenties Reef should be completely removed; that the shoal of 26 feet depth between this channel and Buttermilk Channel should be deepened, and the shoals along the shores at the Battery and Governors Island should be removed It is estimated that such an improvement of the channel would cost $2,210,000.

In transmitting the report to this office the division engineer, Col. G. L. Gillespie, Corps of Engineers, concurred in the views of the local officer that the improvement of the channel between the Battery and Governors Island in the manner proposed, including the deepening of the shoals along the shores of the channel, is a work of public importance which is worthy to be undertaken by the United States, and which is justified by the interests of commerce involved.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. DANIEL S. LAMONT,
Secretary of War.

REPORT OF MAJ. H. M. ADAMS, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
New York City, February 24, 1897.

GENERAL: I have the honor to submit the following report* upon the survey of the "channel between the Battery and Governors Island,

* The map illustrating this report is printed in House Doc. No. 337, Fifty-fourth Congress, second session

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New York, with a view to making a channel continuous with Buttermilk Channel thirty feet in depth and one thousand two hundred feet in width," made in compliance with the provisions of the river and harbor act of 1896.

The channel between the Battery and Governors Island is the water route between the North River on the one side and the East River and Buttermilk Channel on the other. It is the main channel between the East River and the Narrows, being much more used than the alternative Buttermilk Channel. The least width between the Battery and Governors Island is 2,700 feet, of which 1,500 feet has a depth of 26 feet or more at low tide. Near the east end of this channel, where it broadens out into East River and Buttermilk Channel, lie Dimond Reef, which consists of two ledges near together and covering a triangular area about 800 feet long and 600 feet greatest width, and Coenties Reef, about 280 feet long and 150 feet wide. These two reefs are a quarter of a mile apart. Coenties Reef was removed to 26 feet depth in 1875, and Dimond Reef was completed to the same depth in 1892. The deepening of these rocks and the dredging of the north part of Buttermilk Channel to 26 feet depth (finished in 1891) gave an unobstructed area of that depth between the several channel ways along the New York, Brooklyn, and Governors Island shores. Twenty-six feet below mean low water is the depth which has been sought by all these improvements hitherto.

From the channel between the Battery and Governors Island southeasterly to a point in Buttermilk Channel just northeast of Governors Island there is a narrow natural channel 28 feet deep, and northeasterly to the north end of Buttermilk Channel and the lower end of East River there is a natural channel 30 feet deep and 600 feet wide. The latter is by far the more important; it is the most crowded of the main waterways of New York Harbor, carrying all the traffic between the North and East rivers, and nearly all that between the East River and the lower bay; it is crossed by four of the principal ferries and by three smaller ones; it carries upon car floats a great part of the through railroad freights between the West and the New England States; it is used by the largest of the passenger and freight steamer lines from New York to Connecticut and Rhode Island, and by four of the principal Southern ocean steamship lines; it is constantly traversed by tugboats with and without tows. Of this traffic fully nine-tenths passes the Battery side of the channel, which together with the rapid current makes navigation at this point especially difficult.

To widen the 30-foot channel between the Battery and Governors Island to 1,200 feet width at the least expense would involve dredging along the northeast shore of Governors Island and removing part of Dimond Reef, at a total estimated cost of about $500,000. This would make an increased depth over only the least used part of the channel, and would leave the ragged edge of Dimond Reef a very serious source of danger. When an improvement of this channel is undertaken it should include all that is necessary or practicable to relieve its crowded condition and to make it accessible from the East River and the upper end of Buttermilk Channel. Dimond Reef and Coenties Reef should be completely removed, the shoal of 26 feet depth between this channel and Buttermilk Channel should be deepened, and the shoals along both the Battery and the Governors Island shores should be removed. Anything less than this, though it might comply with the language of the act of Congress, would impair its object and would not afford the improvement which this very important waterway requires.

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Following is an estimate of the cost of such an improvement of the channel as is outlined above:

Removing shoals around the Battery shore to a depth of 30 feet below mean low water, 957,000 cubic yards of sand, stones, and bowlders, at 45 cents per cubic yard	$430,650
Removing shoals along the north shore of Governors Island to a depth of 30 feet below mean low water, 451,000 cubic yards of sand, stones, and bowlders, at 40 cents per cubic yard	180,400
Dredging the main channel between the Battery and Governors Island eastward to Buttermilk Channel, 456,000 cubic yards of sand, stones, etc., at 32 cents per cubic yard	145,920
Removing Dimond Reef, both ledges, to 32 feet depth, 33,000 cubic yards of rock, at $30 per cubic yard	990,000
Removing Coenties Reef to 32 feet depth, 8,700 cubic yards of rock, at $30 per cubic yard	261,000
Contingencies, supervision, etc., about 10 per cent	202,030
Total	2,210,000

The material to be dredged is all hard; around the Battery and Governors Island shores there are in places groups of bowlders or small ledges.

The estimated cost of removing the reefs is based upon the cost of previous work upon these reefs between 1871 and 1892. The chief difficulties which necessitate so large an estimate per cubic yard are the depth, the rapid current which makes it impossible to keep divers upon the rocks except at and near slack water, and the dangers from collision in the crowded channel. On the latter account it would be best, if this work were undertaken, to remove the shoals near the shores first, and give additional width to the channel before beginning work upon the reefs.

There are no data showing the amount or value of the commerce which passes through the channel between the Battery and Governors Island. At different times during January, 1897, for four and one-third hours altogether, the numbers and kinds of vessels passing this channel have been observed, with the following as the average result per hour:

Kind of boats.	Number per hour.
Ferryboats	32
Towboats without tows, and small steamers	25
Towboats with tows	23
Barges, etc., in tow	25
Ships, barks, and brigs, in tow	2
Steam lighters	9
Large steamers	3
Car floats	5
Railroad ferries	1
Total	125

Excluding the ferryboats, the total per hour is 93, of which 87 pass in mid-channel or nearer the Battery shore.

As nearly as can be estimated the observed traffic would be a fair average for ten hours of the day and nearly three times too great for the other fourteen hours, which would make the total traffic per day fifteen times that observed per hour.

Similar observations made in summer would show a greater number of vessels; at that season there are from 50 to 100 excursion steamers daily passing the Battery, together with many pleasure boats, and

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large fleets of canal boats and barges from the Erie Canal and Upper Hudson, whose navigation is now shut off by ice.

Very respectfully, your obedient servant,

H. M. ADAMS,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

F 39.

SURVEY OF ELIZABETH RIVER, NEW JERSEY.

[Printed in House Doc. 322, Fifty-fourth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., February 26, 1897.

SIR: I have the honor to submit the accompanying copy of report, dated February 16, 1897, by Maj. H. M. Adams, Corps of Engineers, of the results of a survey of Elizabeth River, New Jersey, made to comply with the provisions of the river and harbor act of June 3, 1896.

The plan of improvement submitted provides for dredging so as to obtain a channel from 6 to 7 feet deep at mean high water from the mouth of the river up to Bridge Street Bridge at the city of Elizabeth. The cost is estimated at $12,000. An annual expenditure, estimated at $6,000, would be required to maintain the proposed channel depth.

In transmitting the report to this office Major Adams expressed the opinion that the proposed improvement is not worthy of being undertaken by the United States, as the increased depth to be obtained by dredging would last but one or two years, and that the work of maintenance would involve an expense not justified by the interests of commerce. These views were concurred in by the division engineer, Col. G. L. Gillespie, Corps of Engineers, and are approved by me.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. DANIEL S. LAMONT,
Secretary of War.

REPORT OF MAJ. H. M. ADAMS, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
New York City, February 16, 1897.

GENERAL: I have the honor to submit the following report upon a survey of the "Elizabeth River, New Jersey," accompanied by a map* of the survey, made in compliance with the provisions of the river and harbor act of 1896.

The Elizabeth River is in the eastern part of the State of New Jersey, and empties into the Arthur Kill, about 1 mile south of Newark Bay and about 11 miles from the Battery, New York City, by way of the

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Arthur Kill, the Kill van Kull, and New York Bay. The river flows through the city of Elizabeth, which has a population of 40,000, and thence along the southerly border of the city for a distance of 2 miles to its outlet. A narrow stretch of salt meadow intervenes between the river bank and the upland of the city along the lower reaches.

A preliminary survey of the Elizabeth River, from the mouth to Broad Street Bridge, Elizabeth, was made in 1878 (Annual Report of the Chief of Engineers for 1879, p. 481).

The preliminary survey showed depths at the mean high-water stage of 11 feet at the mouth, diminishing to 3 feet at Broad Street Bridge, Elizabeth, the head of navigation, a distance of 2.7 miles.

The river bed was bare at ordinary low water opposite the principal wharves at Elizabeth.

The natural depth was 3 feet greater previous to the construction of sewers in Elizabeth, which empty into the river.

The improvement of the Elizabeth River was undertaken by the United States in 1879. A total of $43,160 has been appropriated, and about $40,000 expended under a project for improving navigation at high-water stage by dredging a channel 60 feet wide and 7 feet deep at mean high water up to the Broad Street Bridge. The estimated cost of the improvement, as revised in 1881, was $43,160.

The annual commerce carried by the river when the improvement was undertaken was reported as 36,800 tons. The commerce previous to the decrease in the natural depth of the river was estimated to have been in 1870 about 125,000 tons.

In 1884 the sum of $27,000 had been expended in dredging a channel 50 feet wide and 7 feet deep at mean high water, a distance of 7,000 feet, to the Bridge Street Bridge, Elizabeth. It was then stated that "the original project was completed so far as present wants of commerce require." No further appropriation was made until 1890. Subsequent to 1890 the sum of $16,160 has been appropriated and $13,000 expended in maintenance, leaving a balance on hand of about $3,160 available for continuing the improvement.

The reported annual commerce since the improvement was undertaken has varied between 20,000 tons and 40,000 tons. There is no apparent connection between fluctuations in the commerce and the condition of the river channel.

The field work of the map now submitted was executed October 5 to 13, 1896, and comprises a resurvey from the New York and Long Branch Railroad Bridge to Bridge Street Bridge, Elizabeth, a distance of 1.5 miles. The section of the river below those limits, shown on the map, is from a survey made in 1892; the section above, from a survey made in 1878. The map shows a narrow channel, 30 to 50 feet wide, with center depths at mean high water as follows:

Center depths.

	Feet.
Arthur Kill to New York and Long Branch R. R. Bridge, distance 1 mile	7 to 11
New York and Long Branch R. R. Bridge to John street, distance 1.9 miles	6 to 7
John street to South street, distance 2.2 miles	5 to 6
Vicinity of South street	6 to 7
South street to Broad street, distance 2.5 miles	3 to 6

The river below the railroad bridge has undergone little change since the preliminary survey. Between the railroad bridge and Summer street there has been no material change since 1892; but the river has maintained only 1 foot of the 2 feet increased depth due to dredging in 1879–80.

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Above Summer street the river under present conditions is able to maintain a depth of about 5 feet to Elizabeth Center and 4 feet to Bridge street. Bridge street is practically the head of navigation.

The localities where shoaling is most marked are in the vicinity of the John street sewer outlet, at South Street Bridge, where two trunk sewers discharge, and along the wharves in Elizabeth Center, where the river bed rises and underlying shale rock is found in places above the depth required by the old project. Increased depth made by dredging is lost in from one to two years by the discharge from the sewers.

The following estimate for obtaining a channel 6 to 7 feet deep at mean high water to the Bridge Street Bridge is submitted:

Estimate.

For dredging a channel 40 feet wide and 7 feet deep at mean high water, from Summer street to Bridge street, a distance of 0.9 mile:	
Dredging 18,000 cubic yards in place, at 60 cents per cubic yard	$10,800
Engineering and contingencies	1,200
Total cost	12,000

Estimate for maintenance.

To maintain the depth provided for in the above estimate would require an average annual expenditure for dredging estimated at	$6,000

The river and harbor act of August, 1894, provided for a "preliminary examination of Elizabeth River, New Jersey, to report upon the desirability of placing locks in the mouth of said river." The report was unfavorable (Annual Report of the Chief of Engineers for 1895, p. 1011).

Very respectfully, your obedient servant,

H. M. ADAMS,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

F 40.

SURVEY OF RAHWAY RIVER, NEW JERSEY, FROM ITS MOUTH TO MAIN STREET BRIDGE, RAHWAY.

[Printed in House Doc. No. 254, Fifty-fourth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., January 30, 1897.

SIR: I have the honor to submit the accompanying copy of report, dated January 25, 1897, with map,* by Maj. H. M. Adams, Corps of Engineers, of the results of a survey of Rahway River, New Jersey, from its mouth to Main Street Bridge, Rahway, made to comply with the provisions of the river and harbor act of June 3, 1896.

The plan of improvement proposed provides for dredging a channel 8 feet deep at mean high water and 100 feet wide from First Island up

*Not reprinted. Printed in House Doc. No. 254, Fifty-fourth Congress, second session.

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to Main Street Bridge, a distance of 2 miles, at an estimated cost of $108,000. A channel exceeding this depth and width already exists up to First Island.

In transmitting the report to this office Major Adams expressed the opinion, based upon the reasons given, that the proposed improvement is not justified by the interests of commerce involved. The views of the local engineer are concurred in by the division engineer, Col. John M. Wilson, Corps of Engineers.

Very respectfully, your obedient servant,

A. MACKENZIE,
Acting Chief of Engineers.

Hon. DANIEL S. LAMONT,
Secretary of War.

REPORT OF MAJ. H. M. ADAMS, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
New York City, January 25, 1897.

GENERAL: I have the honor to submit the following report upon a survey of the Rahway River, New Jersey, from its mouth to Main Street Bridge, Rahway, accompanied by a map of the survey, made in compliance with the provisions of the river and harbor act of 1896.

The Rahway River drains a small area of eastern New Jersey and finds an outlet in the Arthur Kill, about 3½ miles south of Elizabethport. The city of Rahway, with a population of about 8,000, is on the banks of the river. Below Rahway the river winds through an expanse of salt meadow in broad shallow reaches, traversing a distance of 5 miles before reaching the Arthur Kill.

A preliminary survey of the Rahway River was made in 1878 (Annual Report of the Chief of Engineers for 1879, p. 483). At that time there was a depth of 8 feet at mean high water up to Bricktown, 3⅝ miles; 7 feet to Edgar's Dock, 4⅛ miles; 4.4 feet to Milton Avenue Bridge, 4¾ miles, and 4 feet to Main Street Bridge, Rahway, 5 miles.

The improvement of the river was undertaken by the United States in 1879.

A total of $37,000 has been appropriated and expended under a project for improving navigation at high-water stage by dredging a channel 100 to 125 feet wide and 8 feet deep at mean high water from Bricktown to Main Street Bridge, Rahway, the head of navigation, a distance of 7,500 feet. The estimated cost of the project as revised in 1882 was $66,250.

When work was finally suspended, in 1883, a channel had been dredged 7 feet deep at mean high water (equal to from 3 to 4 feet at mean low water) and 100 to 50 feet wide for a distance of 3,800 feet and up to within 550 feet of the head of navigation. Below the locality of dredging there was a natural depth of more than 7 feet. The commerce of the river previous to improvement was stated to be 120,500 tons. In 1883, after suspension of work on the improvement, the commerce was rated at 51,000 tons. It was stated at this time that there had been no material increase in traffic by river, and no regular line of transportation had been established, as was anticipated, owing to the scant benefit afforded by the improvement.

In 1886 the improvement was reported as having been a benefit to shippers, but there had been no increase in commerce.

The dredged channel had rapidly filled from material brought down

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by the river in time of freshet and from a steady deposit due to the sewage emptying into the river along the line of the dredged channel. The principal benefit from the improvement was a reduction in the railroad freight rates. The total commerce of the river was reported in 1890 as about 1,000 tons. A slight increase was reported in 1891 to 1893. The work was dropped from the list of river and harbor improvements in 1895.

The field work for the map now submitted was executed October 14 to 30, 1896. A base line was measured and a triangulation was extended to cover the extent of the survey. The plane of mean high water used was determined at Elizabethport by United States engineers in 1872, and is the same as the plane previously used for the surveys of the Rahway River. Soundings were made at frequent intervals along transverse and oblique sections, as indicated on the map. The bridges, docks, and bulkheads along the river were located. Borings were made to a penetration of more than 8 feet below the datum plane at the center and sides of the channel along each cross section above the New York and Long Branch Railroad Bridge. Rock and scattered bowlders were located and detailed.

This survey shows little change from the condition in 1878, when the preliminary survey was made. There is a channel 8 feet deep at mean high water 100 to 300 feet wide from the Arthur Kill up to First Island, distance 3 miles; 7 feet deep and 40 to 100 feet wide to Edgar's Dock, 4⅛ miles; above Edgar's Dock, where previous dredging was located, there is a depth of 6 feet and width of 20 to 40 feet for a distance of 3,800 feet; over the remaining 800 feet to the head of navigation the depth is from 3 to 5 feet. At mean low-water stage the depths are 4 to 5 feet less than those given above.

The bed of the river above the New York and Long Branch Railroad Bridge is composed of hard packed sand, gravel, cobblestones, and occasional bowlders. At two localities what appears to be ledge rock was found in the bed of the channel projecting above the proposed depth of improved channel.

In the city of Rahway the docks and bulkheads have a frontage of 1,200 feet. At Bricktown there is a frontage of 700 feet. There are six small docks at other points along the river.

An estimate is submitted of the cost of dredging a channel 8 feet deep at mean high water and 100 feet wide from First Island to Main Street Bridge, Rahway, a distance of 2 miles. (A channel of more than this depth and width extends up to First Island.)

ESTIMATE.

Quantities:	Cubic yards.
Material lying above the required depth	54,000
Allowance for 1 foot overdepth in dredging	43,000
Allowance for minimum cutting bank of 2 feet	11,500
	108,500
Allowance for scow measure (20 per cent)	21,700
Total to be removed	130,200

Cost:	
Removal of 130,000 cubic yards sand, gravel, etc., at 75 cents	97,500
Removal of 30 cubic yards rock, at $20	600
	98,100
Engineering and contingencies	9,900
Total estimated cost	108,000

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The execution of the above project would make Rahway accessible at high-water stage to the smallest class of barges and sail vessels employed in the vicinity of New York Harbor.

The work of improvement performed by the United States during the years 1879–1883 did not build up commerce, because the channel width secured was not sufficient for the purposes of navigation and because the commerce could be handled more conveniently and economically by railroad.

The river is susceptible only of a limited improvement, such as would admit of navigation at high-water stage.

The cost for such improvement would be large in proportion to the possible benefits.

Maintenance would be necessary and costly, and is not provided for in the above estimate.

Very respectfully, your obedient servant,

H. M. ADAMS,
Major, Corps of Engineers.

Brig. Gen. W. P. CRAIGHILL,
Chief of Engineers, U. S. A.

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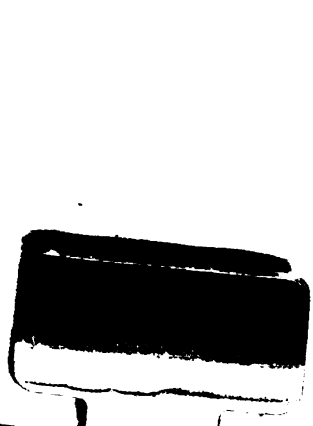

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